THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 45. Thursday, November 5, 1931. No. 794.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 3321*).

Forthcoming Events.

NOVEMBER 9.

Institute of Metals (Scottish Local Section):—Ordinary meeting at Glasgow. "Experiences with some Electric Furnaces for Melting Copper and Copper Alloys," lecture by W. L. Govier.

NOVEMBER 10.

Institute of Metals (North-East Coast Local Section):—Ordinary meeting. "Die-Casting," Paper by A. H. Mundey.

Sheffield Metallurgical Association:—Ordinary meeting. "Methods of the Determination of Physical Properties of Steel," Paper by J. Woolman, M.Sc.

NOVEMBER 13.

Institution of Welding Engineers:—Ordinary meeting at Birmingham. "Some Details of the Progress Reached in Forge and other Welding in Boiler Works Practice," Paper by E. W. Thompson and A. Jeavons.

West of Scotland Iron and Steel Institute:—Meeting at Glasgow. "Microphotography," Paper by A. Macdougall.

Institute of Metals (Birmingham Section):—Meeting at Birmingham. Open discussion on "Mechanical Testing."

NOVEMBER 16-21.

Public Works, Roads and Transport Congress and Exhibition, at the Royal Agricultural Hall, London.

Institute of British Foundrymen.

NOVEMBER 7.

Lancashire Branch:—Lecture on "Production of Castings in a Modern Malleable Iron Foundry," by H. J. Beck.

NOVEMBER 11.

Birmingham, Coventry and West Midlands Branch:—Ordinary meeting. "Some Recent Developments in Automobile Cast Iron," Paper by T. R. Twigger.

NOVEMBER 12.

Lancashire Branch (Burnley Section):—Ordinary meeting at Burnley. "Series of 10-Minute Papers."

NOVEMBER 13.

Middlesbrough Branch:—Ordinary meeting. "Survey in the Making of Light Castings," Paper by F. Harris.

Britain United Unlimited.

It is not our custom to refer in our columns to purely political events and changes, but the bearing of the general election on industry is so evident that some reference to it is almost unavoidable. There is no doubt whatever that the election will become historic, and indeed may mark the beginning of a new era. This is of vital importance to industry, because in these days politics does not merely concern itself with administration. It is bound up very closely with economics, and in a real sense the development of trade has outrun our political machinery, because trade is international, whereas government is national, and to the list of nations additions are periodically made. This is the biggest problem politics has to solve.

The election may, too, be a good omen for industry. It shows that in a crisis class barriers which are usually considered to be insurmountable cease to exist and the free vote of a free people has entrusted a tremendous responsibility to a truly national Government. It is a terrific argument for democracy in a world torn by revolutions and governed by dictators. It shows that in a time of crisis the British people can rise above their own immediate individual material interests and can listen to unpleasant facts. It answers at a stroke much of the criticism, for example, of the influence of the dole in weakening the fibre of the people. Much of this talk has come from America, where immense sums disbursed, for instance, to distressed farmers and to ex-service men are not called doles.

If the election proves that we are still a people who do not expect something for nothing, who would rather work than wait, does not that carry the suggestion that in the same spirit a complete revolution may take place in our industrial output? To get back our place in the sun as an exporting nation and to maintain our high wage standards high production is necessary; a revision of restrictions on output and willing co-operation between employers and employed would do much to make a difference in the situation. The nation to-day is united more than at any time since 1914. If the spirit so strikingly emphasised in the political sphere can be applied to industry, there is no doubt whatever that the unemployment figures would soon begin to fall, trade improve, with the result that taxation would diminish. Britain at last resumes her place as leader in the councils of the nations. If she will, she can do the same in industry.

The Medium-Sized Ironfoundry.

Last week we dealt with the position of the small isolated country jobbing foundries, and tendered some advice for their material improvement. The case of the larger, but not the quantity-production, shops is infinitely more interesting, because they are all without exception undergoing a peripetetic metamorphosis. Some have recently bought new sand plant, others cupolas, sand blast, moulding machines and so on. Thus the average large jobbing plant at the moment is a queer mixture of the old and new. A clear recognition of this is evident in a chat with the foundry management, because they invariably state, "I dare not ask for any more plant just yet, as only last year I got the directors to buy me a new cupola or a sand blast, or sand mill, and though I badly want a sand plant or a sand blast or a cupola, I must wait until the plant now installed has more or less paid for itself." Obviously, there is no common denominator in foundry practice, primarily because the section proposed to be replaced varies in its antiquity, but the results of very careful costing of any sectional operation can be submitted to the general management with a request that they ask some suppliers to state what savings the installations would effect. Thus the foundry section has not asked for any new plant, and the onus of modernisation is thrown upon the higher authorities. If this has been done with each section, then an instrument has been placed in the hands of the foundryman to indicate that certain orders would not have been lost and others would have been more profitable. That a certain percentage of wasters would not have been made if hotter metal or more permeable sand was available. That so-and-so's business would have been retained if the castings had been sand-blasted, as Jones' castings always have a better saleable appearance. Yet the fundamental aspect of this intense costing analysis which we advocate is to show uncontrovertably which section most urgently requires replacement.

XUM

The New Parliament.

FOUNDRY & ENGINEERING REPRESENTATIVES.

The National Government was returned to power by the General Election with an overwhelming majority. Many of the successful candidates are associated with the foundry, engineering and allied industries, and brief notices of these members, with the constituencies they represent, are appended:—

Accrington.—Major H. A. Procter is an engineer. His inventions for dealing with pulverised coal firing are in use in many countries.

Barnstaple.—Sir Basil Peto is a director of the Morgan Crucible Company, Limited.

Birmingham (Duddeston).—Mr. O. E. Simmonds is an aeronautical engineer, and chairman and managing director of Simmonds Aircraft, Limited.

Birmingham (King's Norton).—Major L. Beaumont Thomas is a director of Messrs. Richard Thomas & Company, Limited.

Birmingham (Mosely).—Mr. P. J. H. Hannon is vice-president of the National Union of Manufacturers and a member of the executive of the Federation of British Industries. He is a director of the Birmingham Small Arms Company, Limited, and other companies.

Blackburn.—Lt.-Col. Sir Walter Smiles is by profession an engineer.

Bradford (East).—Mr. Joseph Hepworth is an engineer and managing director of Messrs. Hepworth & Grandage, Limited.

Cheltenham.—Sir Walter Preston is a director of Messrs. J. Stone & Company, Limited, Platt Bros. & Company, Limited, and John Baker & Bessemer, Limited.

Consett.—Mr. J. P. Dickie is an engineer.

Glasgow (Hillhead.)—The Rt. Hon. Sir Robert Horne is a vice-president of the British Electrical and Allied Manufacturers' Association, Inc., and chairman of the Howden-Buell Combustion Company, Limited, Imperial Smelting Corporation, Limited, and National Smelting Company, Limited.

Glasgow (Tradeston).—Dr. W. H. McLean is a member of the Institute of Civil Engineers.

Halifax.—Mr. Gilbert Gledhill is a director of Messrs. Gledhill & Sons, Limited.

Ilford.—Sir George Hamilton is an electrical engineer.

London (Leyton, East).—Sir Frederick Mills, Bt., an engineer by profession, is well known for his connection with the Ebbw Vale Steel, Iron & Coal Company, Limited, of which he was formerly chairman and managing director.

London (Leyton, West).—Sir Wilfrid Hart Sugden, a member of the Bar, is a steel and constructional engineer.

London (Lewisham, West).—Sir Philip Dawson, of Messrs. Kincaid, Waller, Manville & Dawson, consulting engineers, has been a member of the Disposals Board of the Ministry of Munitions, of the Electrification of Railways Advisory Committee of the Ministry of Transport, and of the Water Power Resources Committee of the Board of Trade. Among other companies, he is chairman of Duffield Coal Products, Limited, and the Duffield Iron Corporation, Limited, and director of Messrs. Johnson & Phillips, Limited, and the Wallerawang Collieries, Limited.

London (Fulham, East).—Sir K. P. Vaughan-Morgan is a director and vice-chairman of the Morgan Crucible Company, Limited.

Lowestoft.—Sir Gervais Rentoul, K.C., is President of the British Ironfounders' Association.

Merioneth.—Mr. H. Haydn Jones is an iron merchant.

Midlothian and Peebles (Northern).—Major John Colville is a director of Messrs. Colvilles, Limited, and Smith & McLean, Limited.

Newport.—Mr. R. G. Clarry, consulting engineer, is a director of Messrs. Simon Bros. (Engineers), Limited, among other companies.

Sheffield (Hallam).—Mr. Louis W. Smith has been for many years a member of the Institution of Mechanical Engineers. He is a permanent director of Agricultural & General Engineers, Limited, and chairman of Clarke's Crank & Forge Company, Limited.

Swansea (West).—Mr. Lewis Jones is secretary of the South Wales Siemens Steel Association.

Wallasey.—Lt.-Col. J. T. C. Moore-Brabazon, who has been Parliamentary Secretary, Ministry of Transport, is a director of "B. & L." Powdered Fuel, Limited, "L. & N." Coal Distillation, Limited (chairman), Leicestershire Colliery & Pipe Company, Limited, Leicestershire (L. & N.) Coal Distillation, Limited, and other companies.

Willesden (East).—Mr. D. G. Somerville is a director of Messrs. D. G. Somerville & Company, Limited, engineers, and other companies.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Strength of Cast Iron in Relation to Thickness.

To the Editor of The Foundry Trade Journal.

Sir,—With regard to the letter I wrote you on the above subject, I find there is an error in the original text. In the fourth line below Fig. B it should read, "we have then a cylinder 1 in. inside diameter" (not 2 in.), etc. This does not affect the calculation which follows, *i.e.*, the ratio between area of inner core and outer cylinder, both of which are based on the present figures.—Yours, etc.,

John Shaw.

Southsea,
November 1, 1931.

Notes from I.B.F. Branches.

The London Junior Section of the Institute of British Foundrymen held a meeting at the offices of The Foundry Trade Journal on October 30, when Mr. H. J. Young spoke on the subject of "Cast Iron." Mr. L. H. Howell, the chairman, presided.

Mr. Young based his remarks upon a selection of lantern slides, the first of which illustrated a large cast-iron liner for a marine Diesel engine—a difficult type of casting to make successfully. It was cast in a loam mould, was 4 in. thick, weighed 6 tons with the head, and had to be deeply machined. For testing purposes the test-bar was cut from the head; and since the worst metal was contained in that part of the casting, if these test-bars yielded satisfactory results, one was certain then that the casting was satisfactory. Any separately cast test-bar, unless of grotesque dimensions, in this case would be of white iron. Some fifteen years ago the strength of the iron used for these liners was about 16 tons; to-day it was 18 tons. In connection with Diesel-engine work, chaplets were to be avoided.

A later slide showed the microstructure of a sample taken from that section of a casting where it had been repaired by burning-on. The original metal was shown to be soft, whereas the welding metal was chilled; between the two there was a distinct demarcation. Burning-on was not wholly successful, but efforts should always be made to repair heavy castings on economic grounds. A common cause of the failure of such castings as reciprocating-engine cylinders was that engineers very frequently specified insufficient machining allowance on the top flange. The flange contained the weakest metal in the casting, as the *débris* of the mould rose to the surface, and this weak metal was not completely machined off. A table was shown which indicated that in large castings the iron at the bottom was always slightly stronger than that at the top.

The remainder of his talk Mr. Young devoted to describing the various graphite forms, introducing the analogies of sugar and water and the carraway-seed cake. He was cordially thanked for his address on the proposal of Mr. Howell, seconded by Mr. Vincent C. Faulkner.

The October Bulletin of the American Foundrymen's Association announces the following new memberships from the British Empire:—Barrow Hematite Steel Company, Limited, Barrow; Mr. A. Harley (President of the Institute of British Foundrymen), the Daimler Company, Limited, Coventry; Mr. J. A. Richards, the Crane Foundry Company, Limited, Wolverhampton; and the D. M. Storie Fittings, Limited, Oshawa, Ontario, Canada.

Random Shots.

What a fascinating experience it is ("Now there goes 'Marksman' again, all wings and no tail!") to be present at a round-table meeting of junior foundrymen. Especially so when one of those same "old stiffs" to whom Mr. Dews has made reference has consented to address the youthful enthusiasts. The "old stiff" (unkind expression) becomes so marvellously rejuvenated that halfway through his talk I always begin to wonder whether he couldn't see the next day's football match for half price! Apart from this altogether novel phenomenon, the junior meetings, I suggest, equal the senior meetings in interest because of their peculiar intimacy. The attendance is not great, perhaps not as great as is desired sometimes; and the lecturer has no objection, indeed is patently eager, to slip round to an inquirer and clear up a point by sketches, whether it is important or not. And how often those sketches leave the meeting in a breast pocket!

* * *

Another appealing feature is the "clean breast" a senior lecturer will make when speaking of his practical experiences—and repeatedly he leaves the realm of theory to delve into practice for an illustration. He launches into details of individual jobs—so intriguing that "Marksman's" ears distend visibly—of a nature that are seldom revealed before the serried ranks of listeners (and competitors) at senior meetings. And—it's all very jolly!

* * *

Now "Marksman" was about to urge you all to attend these junior meetings. On second thoughts, no. Probably you would find them so much to your liking that in a brace of shakes they would be subtly modified into "Senior meetings, juniors invited." Of course, there is the chance that you might forget your own meetings, and attendances at them dwindle down to those same ousted youths, who then might resort to the kidnapping of one in your midst in order to procure a lecturer. And so the junior meetings would be perpetuated.

* * *

But let's be "Safety First" and take no risks. I have a plan! A conspiracy! (And surely a man is allowed one conspiracy on November the Fifth, Mr. Editor?) The Branch Council approaches the secretary of the Junior Section, and having duly humbled itself, offers the Section a suitable room for its meetings. This room shall be bounteously provided with keyholes, fanlights, skylights, crevices in panellings, spyholes. A junior meeting having commenced, the senior members post themselves at the afore-mentioned points of vantage, and "attend" the meeting thus. Indeed, enthusiasts could conceal themselves under the platform before a meeting began, and adventurous latecomers mount to the roof, there to listen at the chimney pot.

* * *

INTERLUDE.

The Editor: You appear to have ignored in your idea one of the outstanding inventions of the age.

"Marksman": Which of the three is that?

The Editor: Merely the microphone.

"Marksman": So I have! Well, I shall offer the idea to Heath Robinson, unless you care to have it?

The Editor: The basic underlying principle of your idea is as old as the Domestic Servant.

* * *

Old Lady (to Presiding Officer of polling booth): "I want to vote for Mr. MacDonald."

P.O.: "You can only vote for his representative here."

O.L.: "I don't want no representative, I want to vote for MacDonald 'isself."

P.O. (facetiously): "Then you'd better get an aeroplane and go to Seaham."

O.L.: 'I don't want to see 'im. I want to vote for 'im. *(Exit indignantly without voting.)*

Marksman.

Industrial Policy as Affecting the Iron and Steel Industry.*

A REVIEW OF POST-WAR CONDITIONS.

By Sir William J. Larke, K.B.E. (Director of the National Federation of Iron and Steel Manufacturers).

We have seen in the past year the remarkable spectacle of the industrial world drifting to apparent bankruptcy in the midst of plenty, from which the somewhat hasty deduction is frequently drawn, that the world is suffering from over-production.

There is much evidence to indicate that this is not the case, but that the real evil is the mal-distribution of gold, and as a consequence the ordinary medium of exchange between the products of agriculture and those of industry is dislocated. The production of the iron and steel industries of any highly-industrialised country in which the industry is well developed, is a measure of the prosperity of that country. If the production of pig-iron is considered as a measure of the general prosperity and consuming power of the world, it will be found that from 1810 to 1910 the world production of pig-iron increased by 6 per cent. per annum; from 1910 to 1914 by 6.2 per cent. per annum; showing that the rate was, as might be expected, increasing rather than decreasing, since the consumption of iron and steel per head of population was increasing with the progress of modern invention. Had this rate of increase persisted without interruption from 1914 to 1929, the record year for iron and steel production, the world consumption of pig-iron would have reached 160 million tons; whereas it only reached 100 million tons and the world productive capacity was only 107 million tons.

Every influence except that of the aftermath of the war was calculated to increase the rate of consumption, and yet there was this remarkable disparity between the potential and the actual consumption. It must, however, be recognised that the improvement in the mechanical qualities of iron and steel which modern research is achieving may discount in the future to some extent tonnage as a measure of progress.

Lack of Purchasing Power.

It seems clear that present industrial depression is due not to the absence of need but to the lack of purchasing power. In the pre-war world the basis of international exchange had been for this country since 1816 a gold-standard currency, which was followed by the major part of the Western world, and by the United States in the early seventies. During that period, as each country had developed its natural resources in a world where competition was regulated for the most part as regards the producers' home market by tariffs, but in neutral markets was open, each country had created the facilities for financing its own development and production, both by the natural acquisition of wealth and by demonstrating its wealth-producing potentialities to the satisfaction of its creditors; so that it was able to borrow on the expectations of the future, and thus accelerate its natural development.

Post-War Conditions.

As a result of the war, the distribution of credit throughout the world was entirely deranged. In the post-war years the policies followed in regard to war debts, reparations, and as a result of the development of the spirit of nationalism to an intense degree, the erection of high tariff barriers, in an attempt by each country to render itself as nearly as possible self-sufficing, have had the effect that none of the creditor countries except Great Britain was willing to accept payment of reparations or war debts in goods or services—the only media in which indebtedness between nations can be settled for an indefinite period and to an indefinite amount—with the result that while the indebtedness remained and payment was exacted, the payments had to be made in gold, the world stock of which was limited, and has proved insufficient to meet the demands made upon it.

The debtor countries being themselves on a gold basis, were denuded of their gold resources, and the volume of their currency in circulation was reduced, although owing to increasing population their currency needs were increased. If the volume of currency in any country is falling and its volume of production is increasing, it follows that since the products of their industries and agriculture are much greater in relation to their currency in circulation, that their commodities are worth less to their nationals in terms of money, than they would be if there were sufficient currency to finance the volume of their production at economic prices; hence their shortage of currency produced a catastrophic fall in prices internally and internationally, since they were driven to endeavour to realise on their produce as a means of satisfying their needs, at whatever price the world was willing and able to pay for them.

World Collapse of Commodity Prices.

With the drift of gold to those countries which refused to accept payment of their indebtedness in goods or services, namely the United States and France, all the debtor countries were in the position of requiring to meet their national needs by realising their produce at whatever price they could obtain for it, and since their trade was not only with the creditor countries, but between themselves and in neutral markets, the natural result of such a forced realisation has been a world collapse of commodity prices, to a level that has little or no relation to the cost of production. While prices have also fallen considerably in the United States, this has been due to the deliberate withholding of their gold from circulation to prevent an abnormal rise above the world price level which must otherwise have occurred, but even more directly to the collapse of a speculative boom almost unprecedented even in that country in magnitude and character.

Collapse of Silver.

Coupled with this general disturbance has been the position in Russia and China, and the decrease in the purchasing power of India. The position in China and India has undoubtedly been aggravated by the collapse in the value of silver, which has been brought about by the devaluation of silver resulting from the large surplus stocks of silver that have accumulated in this country and India by the debasing of the silver currency in this country and the adoption of a gold standard for the rupee.

As a consequence many hundreds of millions of ounces of silver have been accumulated, and have been placed on the market at different times, without apparent regard to the influence that such disposal would have on the world value of silver; thus the purchasing value of the teeming millions of China has been reduced by more than half in the past few years, and grave discontent has been occasioned in India by the depreciation of the value of the silver hoarded by the Indian people.

For this disturbing condition there would appear to be no real need, since the world production of silver for the past 400 years has had a definite relation to the production of gold, in the ratio of about 14 ozs. of silver to one of gold, and the world has absorbed even in the last year or two, each year, the full annual production of silver. Thus it is evident that the collapse in the value has been solely due to the disposal of the accumulated hoards of silver resulting from the change in the British and Indian silver-currency policies, which were followed by similar steps being taken in French Indo-China.

To this extent, therefore, the depression in the last few years in the silver-currency countries appears to be due to artificial causes, which although requiring international action and assent for their removal, could be readily adjusted.

British Policy *v.* Trade Depression.

Dealing with the special problems of this country it will be found that our own policies have contributed in no small measure to the relatively greater depression which this country has experienced as compared with other industrial countries. Between 1920 and 1929 all our principal competitors have experienced periods of very great prosperity; whereas this country has experienced an unrelieved period of industrial depression since the autumn of 1920. The difficulties of this country have thus been far greater than those of other industrial countries.

The reasons appear to be that our earnest and well-intentioned endeavour to give a lead to the world in the immediate post-war years has resulted in imposing upon this country a burden greater than its economic structure can support. By our policy for settlement of war debts, whereby we undertook to accept from Germany only sufficient payments to pay our indebtedness to America, which we had incurred on behalf of the whole of the Allies, and otherwise by absolving our Allies from their immediate indebtedness to us, we hoped to secure a general cancellation of war debts. This has not yet eventuated, and we have therefore carried a heavy burden which we assumed by this policy, amounting to an increase in our capital debt of £900 million sterling, the interest and charges for which have to be provided out of taxation. Whether rightly or wrongly in the individual cases, we have fixed the cost level of a number of our services, such as the cost of social services and the sheltered industries, which are important factors in our national costs of production, without regard to our national ability to support them. In the cost of social services, eminently desirable in themselves, these are now three times what they were pre-war, and the increase has added to the cost in the iron and steel industry some 2½ per cent. Increased railway rates (railways being a sheltered industry), although the Railway Companies have endeavoured to meet the difficulties of the depressed industries, the increases still represent in iron and steel production costs an increase of 7½ per cent. as compared with 1913.

Return to the Gold Standard.

Again in 1925, in an endeavour to secure the return of the world, particularly in competing countries, to a gold standard and thus to reduce the chaotic condition resulting from the different price levels obtaining in different countries, also to remove the difficulties caused by exchange dumping in this country, we returned prematurely as it transpired to the gold standard. Six months before, industry had made urgent representations that the return to the gold standard, and particularly the revaluation of the £, would have very serious repercussions on the competitive power of industry, reducing

* From an Address at a Meeting of the Midland Co-ordinated Metallurgical Societies on October 12.

our export trade, subsidising our import competition and increasing unemployment, since it was considered (as indeed proved to be the case) impossible to reduce wages and costs at that time proportionate to the increased purchasing power of the £.

With the £ now released from the gold standard and free to adjust itself, at its real value to the rest of the world, this difficulty is removed, but at the expense of the introduction of an element of uncertainty in international commercial relations; therefore the stable value of the £ must and will be established in due time whether in relation to gold, or whether a sterling basis for international exchange will be established, time alone can show.

Handicap to British Iron and Steel Industry.

But the result of these three factors, social services, increased railway rates and the revaluation of the £ in 1925, placed a handicap (which was entirely outside the control of the industry) on the competitive power of the iron and steel industry of not less than some 20 per cent. But when in addition to this it is borne in mind that the wage level between Britain and its principal competitors was represented by the following: Great Britain 100, Germany 59, France 47, Luxemburg 44, Belgium 40, and that 50 per cent. of the production of the industry was consumed in the home market which was open to all competitors, who were not subject in their turn to the same burdens of taxation as industry in this country has suffered (as a result of our post-war policies), it will be realised that British industry in the past ten years has been set an impossible task.

Constructive Industrial Policy Essential.

Industry is the foundation of our financial, social and economic structure. This is the most highly-industrialised country in the world with 28 per cent. of its population engaged in industry apart from those employed in agriculture. Therefore the financial, economic and political policies of this country must be concentrated on securing an industrial policy that will ensure the prosperity and continued development and expansion of our industries, without which this country must languish, the standard of life of its people must be debased until it ceases to be a leading country in the councils of the world.

The first step is obviously to relieve industry of the heavy burdens of taxation and additions to cost which have been imposed upon it as the result of our post-war policies. The only step that has been taken in this direction was the derating provisions of the Local Government Act of 1929, whereby industrial establishments were relieved of 75 per cent. of their local rates; this amounted to approximately 2 per cent. reduction in iron and steel costs. But some means must be devised of reducing still further the burdens of transport rates, since the assembly of materials and re-delivery of the finished product in the iron and steel industry represent to-day approximately 25 per cent. of the total cost of the finished product. The burden of social services can only be substantially relieved by restoring prosperity to industry and thus reducing unemployment; relief is therefore dependent upon the application of other methods of creating conditions within which British industry can prosper in proportion to its relative efficiency.

Regulation of Imports.

Since efficiency of production depends on the maintenance of a volume of demand, which will permit of the efficient employment of any productive unit, it is essential that at least equality of opportunity shall be given to British industry in competition in those markets over which British policy can exercise control. The restoration of the adverse trade balance which alone can maintain the stability of the £ in relation to foreign currencies, also demands the restriction of imports into the British market, and therefore some form of regulation of imports must be adopted in the immediate future. Since the revaluation of the £ to gold parity in 1925 has proved to have been such an important factor in producing the industrial depression in this country, the point at which it is ultimately stabilised must be seriously considered in all its bearings by Government and industrialists.

As soon as national finances permit, British industry should be assisted to replace its productive equipment out of revenue, by relieving all industrial reserves of income tax until they are distributed to shareholders in any form, either dividends or bonus shares.

This is only a reasonable and equitable provision having regard to the fact that British industry was severely penalised in the war and post-war years by the operation of Excess Profits Duty. Our industrial equipment was expanded to meet war needs, under war conditions and at war-inflated prices; the major portion of the cost of this expansion was left as a permanent capital charge on British industry. This policy was entirely reversed by all our world competitors. In every case other countries relieved their industry of war capital burdens, and fostered their revival by tariffs, subsidies, special railway rates and cash payments, which resulted in a largely-expanded productive capacity with all the latest improvements, built for Peace development without any commensurate capital responsibility.

International Policy.

The first international problem requiring solution to which a British Government must address itself, is that of establishing a basis of international exchange; whether by a reversion to a gold standard, or the establishment of a sterling basis of exchange by agreement with other countries. It is obvious that a reversion to a gold standard is only possible if agreement is reached with regard to the re-distribution of the gold reserves of the world and the subsequent control of their distribution internationally. For only by the lending of gold by the present creditor countries, notably France and the United States, to debtor countries, can the potential demand of the debtor countries for the products of industry and agriculture be made effective, and the recovery from the present general world depression be ensured.

Such an international Conference might conceivably agree to guarantee the repayment of loans made by creditor countries to debtor countries, and thus reduce the risk of default by debtor countries, which appears to be the reason for lack of confidence on the part of those countries now in a position to lend.

Further, the adoption of some policy of import restriction, whether by tariff or otherwise, would give to the British Government a power of negotiation, both internationally and inter-Imperially, which should result in agreements securing for the products of British industry the *entrée* to markets which are now denied in whole or in part by prohibitive tariffs against them. The development of inter-Imperial trade by mutual tariff concessions between the Dominions and the Mother Country will be rendered to an extent hitherto unrealised.

Such a policy would promote a freer interchange of international trade and approach more nearly towards the ideal of international free trade than has ever been possible for this country to achieve under the existing system.

Policy of Individual Industries.

As soon as this country attempts to control under present world conditions its own economic destinies by arming itself with the means of negotiating reciprocal agreements, a forward policy on the part of industry itself will be rendered possible. Profitable operation has been impossible for the reasons stated, confidence has been destroyed, and enterprise severely handicapped by a continuously falling price level due to an effort to avoid bankruptcy rather than to increase productive efficiency. As a consequence, owing to the loss of competitive power, the iron and steel industries of this country have had to rely almost entirely on the quality factor in competition for the business they have secured.

The general conditions under which the industry has been working have actually reduced its production in 1931 by more than 50 per cent. as compared with 1929, and the imports of foreign material have exceeded the exports during the past year by not less than 550,000 tons.

Every million tons of iron and steel imported into this country, at a conservative estimate, if made in this country from British ore and coal, would find additional employment for 40,000 men. The average wage of these men is upwards of £2 10s. per week, and would thus amount to £5,200,000 per annum. The saving to the country is not more than an average of 30s. per ton representing on 1,000,000 tons £1,500,000; thus the country, for every million tons imported, loses the value of the production of these men, which, at the value of their wages alone, is £5,200,000, and gains £1,500,000, a net loss of £3,700,000. Since upwards of 2½ million tons of iron and steel are now being imported annually, the net loss to the country on these imports alone is over £9,000,000 per annum.

There is a strong *prima facie* case for saying that this work could be retained in the country, particularly if producers and consumers would combine their competitive power in the national interest, as many individual concerns engaged in those exporting iron and steel industries, which claim to be dependent on foreign imported material on the ground of price, have been and are successfully competing in the same markets using British semi-finished iron and steel.

On the other hand, there is a volume of imports which are entirely different in quality, and in fact are not the same material in anything but name, which yet compete in this market to the detriment of our industries, and this is particularly applicable to the wrought-iron industries of Staffordshire and the North. For this kind of competition the education of the user, through publicity based on brands which shall be held to connote particular qualities, is the principal remedy coupled with some regulation of imports where on balance the country as a whole would secure an advantage in increased employment and income.

It is significant that in the year 1929, which was the best year in the history of iron and steel production in the world, the British production plus imports into the British home market were together equal to the productive capacity of the industry. Whatever advantage may have accrued from these imports in assisting the finishing industries to retain their export trade, it is at least significant in the same industries as imported the material, there was in every case a substantial proportion of the productive capacity which was in successful competition in world markets, while using steel of British origin.

There was of necessity a difference in the margin of profit obtainable by the use of the lower priced material from the Continent, but national considerations demand that the relative value of the profit and employment thus accruing to industry from the use of material imported which can be produced within the country must be balanced against the resulting gain in employment and reduction in present loss to the country if such manufactures were produced at home. In making such a balance, obviously the cost of unemployment resulting from either policy must be taken into account.

The difficulty in dealing with these questions on a national basis is that they are seldom or never either expounded or discussed dispassionately apart from some particular vested interests. If we are to achieve a successful

industrial policy, such a policy must be formulated on the basis that the interests of the nation as a whole must be supreme, even though the adoption of a particular policy might involve an immediate hardship. In all cases such hardship should and would obviously be reduced to a minimum, and the transitional period from one system to another must be, so far as possible, governed by the condition that the prejudice to the individual interests should be reduced to a minimum. In any case, it is a truism, no individual can remain prosperous in a bankrupt community any more than a nation in these days can remain prosperous or even solvent in a bankrupt world.

Direction of Industrial Development.

Given the conditions which will create the necessary confidence on which a development of industry involving further expenditure of capital may be properly undertaken it is pertinent to consider in what direction industrial development should proceed, in order to adjust itself most effectively to post-war conditions. Consideration of the post-war position must not be limited or restricted by reference to pre-war traditions or experience. In pre-war days the organisation of industry, although tending towards large aggregations, was still largely on an individualistic basis. Competition was of a straightforward character, and might be said to have depended for its success on the efficiency of the competing unit. Whether the competitive power was obtained from technological superiority or some adventitious advantage arising from the control of the supply of raw materials or some similar factor. In any case the limits of competitive power were usually bounded by the actual cost of production. Unemployment had never reached the same relative proportions and therefore was not a factor which threatened the stability of the social and political order; in these post-war days conditions are entirely different.

As a result of war associations and requirements, and the immediate post-war adjustment to peace conditions, large aggregations of productive capacity were formed under a unified control. The huge inflow of capital for war expansion has resulted in the diversion of ownership of our productive industries over a much wider area, and their control is no longer exercised by those who have their own money largely if not entirely at stake.

Co-operation *v.* Amalgamation.

This development is common to the industrial world, and in the iron and steel industry in particular. Although it has proceeded to a very considerable extent in this country it has not reached the stage of the huge aggregations which are the commonplace of America, Germany, France and Belgium. Certain of our groups approximate in size to certain groups in Continental countries, with this difference that in France and Germany in particular, large groups have coalesced under a common control as to policy, otherwise retaining their individual identity under unified management as in the German Steel Trust, which now controls under one company a productive capacity equal to approximately two-thirds the total capacity of the British iron and steel industry. The United States Steel Corporation has a productive capacity of 25,000,000 tons per annum, being twice that of the British industry.

Complete unity of control of such huge aggregations of productive capacity not so essential as a unified commercial and productive policy where this can be adopted without the difficulties created by amalgamation. It is in the sphere of close co-operation for the development of markets, and the distribution of production amongst units specially designed for a limited range of products to secure the lowest cost and the most efficient results, that probably the greatest and most rapid progress in organisation to meet post-war conditions can readily be made.

Collective Selling Association.

Expressing a personal view—if the separate sections of British industry, whether iron and steel or any other, would organise a collective selling association controlled by a Board with full executive powers, and pooled their present selling expenses in a common endeavour, it would be possible to maintain much more effective representation in the consuming markets of the world *vis à vis* our foreign competitors than is possible under conditions, where each individual constituent of the collective effort is endeavouring to maintain his own representation in competition even with others of his own country.

Representation in foreign markets is much better undertaken by men trained in our own industries with a thorough knowledge of the processes through which the product passes before it is ready for markets. Even in those cases where adequate and competent merchant firms are available in overseas markets, a representative having technical knowledge of the product should be stationed in such markets, in order to assist with his knowledge the commercial representative in competing with foreign products.

It cannot be too strongly emphasised that it is not always or even generally that the lowest price is the essetnial condition in competition. It is the lowest price per unit of service. For example, wrought iron in many cases can be demonstrated to be the cheapest material for a given service over a long period, although the first cost would be much higher than alternative materials; this, however, can only be demonstrated by those having a technical knowledge of the product and service under consideration.

There is another important advantage in having technically-instructed representatives in consuming markets; they alone can demonstrate to the potential customer that there are uses and applications of their products which the customer had never discovered for himself for lack of knowledge of the product in question. Far too often producers appear to consider that their selling responsibility is fulfilled if they meet the demands made upon them by the market; this is where selling commences, not where it ends.

It is the function of a selling organisation to be always creating new outlets for the product with which it is dealing, not the geographical outlet only, but outlets in the sense of new uses and applications; it is to this aspect of the commercial side of industry that attention should be directed by those technically-instructed and highly-educated young men we are hoping to see take up an industrial career. Such a career seems to promise even more for them in the future than ever in the past. With industries organised on a national basis for common action in marketing and the distribution of production, participation in international industrial agreements becomes possible.

International Agreements.

Under present world conditions, where commodity prices are at a level lower than their cost of production in most countries, the methods of adjustment involve, as we have said, international control of monetary policy. But much can be done by individual industries co-operating with industries of a like kind in all countries of the world, and arranging a co-ordinated policy for the development of consuming markets and the maintenance of an economic price level. This has been attempted in the International Steel Cartel, the parties to which are France, Germany, Belgium, Luxemburg and the Saar. The Cartel was designed to limit production to demand on a quota system involving payments into a common fund for every ton produced, fines for exceeding the quota and compensation for deficiency in quota during the accounting period, which was usually quarterly. But this Cartel did not succeed in controlling the price level, and its failure to do so has jeopardised its continued existence.

It has, however, continued in being with varying degrees of success and substantial modifications to its original form, since September, 1926, to the present day. Much can be said under existing world conditions in support of the suggestion that the Cartel should be made comprehensive and effective by including Britain and America Under conditions that have obtained post-war in this country the British industry had no solid basis of negotiation on which to found a quota reasonable in any degree in relation to its productive capacity. The cost level in Britain due to various causes already mentioned was much higher than the Continent, and as a consequence British industry had no negotiating power so long as this country supported an unrestricted market for foreign imports.

Similar potentialities of even greater value are open to us in the Dominion throughout the Empire wherever there exists industries of a like kind. The British iron and steel industry has adopted the policy of co-operation, not competition, within the Empire, and has established close relations with India, Canada, Australia and South Africa. The Empire industries are now eligible for membership of the British National Federation of Iron and Steel Manufacturers, and some have already joined.

In principle the idea of co-operation is fully accepted by the British iron and steel manufacturers, and is under sympathetic consideration by the Dominion industries concerned. Since the Empire market represents upwards of 50 per cent. of the British iron and steel exports, such an agreement, if it could be made effective, would be of incalculable benefit to the iron and steel industries of the Empire.

Some Wonderful Art Castings.

Nothing has given us greater pleasure during the whole of the occupancy of the editorial chair than the receipt of three plaque castings from Prof. Dr. Pisek, Rector of the University of Brno (Brunn). Taking the form of wall plaques, they were presented to the participants in the last Czecho-Slovakian Foundrymen's Association Congress. We do not propose to have these photographed, as we fear that the extraordinary detail would be lost. We propose, therefore, keeping them in this office until the end of November, where they can be inspected by any of our readers. We are convinced that if any firm can manufacture similar art castings in Great Britain, there would be an important market. When congresses of any character are held, we can envisage no better souvenir than a well-finished cast plaque. Some foundries in Falkirk, Willenhall, Derby, Birmingham, Dudley and a few other centres are capable of making excellent castings, but the artistic merit and finish reached by these Czech foundries have to our mind never been excelled. Also, we hope to obtain permission to have them on exhibit at the annual meeting of the British Cast Iron Research Association.

Cast-Iron Road in Accrington.

The Accrington Town Council, having discontinued their tramway system in favour of omnibuses, are taking up the tramway lines and remaking the roads concerned. The opportunity afforded has induced them to repave a portion of Abbey Street, 90 yds. long and 5 yds. wide, with the triangular cast-iron road blocks lately introduced. Howard & Bullough, Limited, Globe Works, Accrington, are making the blocks under licence. The number of blocks required will be about 4,000, and the weight of metal laid about 36 tons.

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Plaster Patterns.

By "Practicien."

Although wood patterns are almost invariably used in all foundries other than repetition shops, there are times when these are too costly for a particular job. In the case of jobbing foundries, it frequently happens that much time and expense has to be spent on a pattern from which only one or two castings are required. The casting may be of intricate design or abnormal shape and may never be ordered again. In such cases the cost of a wood pattern is prohibitive and seems entirely out of proportion with the moulding and metal costs. The "price per cwt." is consequently sent "sky-high" and the customer, unless fully conversant with the difficulties encountered, begins to think he is being exploited, and whenever a customer gets this impression he is apt to look elsewhere for his supplies. In these times no one can afford to lose a customer, especially when the cause of his dissatisfaction can in many cases be remedied by means of plaster of paris.

Disadvantages of Plaster Patterns.

Anyone who has experience of moulding shops will agree that plaster of paris patterns are generally unpopular. Many moulders detest them and will not willingly work from such patterns. There are several reasons why they are unpopular, and from the moulders' point of view they are as follow:—(1) they are easily broken; (2) unless well finished, difficulties in drawing are encountered and consequently more finishing is required; (3) there is generally little provision made for drawing the pattern and tapping has to be done very carefully, and (4) such patterns are as a rule very porous and unless they have been stored in a dry place prior to being used they will sweat when in the mould—the results of which need no explanation.

These are four distinct disadvantages which apparently are perfectly sound. To a certain degree they are, but one must carefully examine the case on its whole merits before condemning it altogether. That such patterns are, generally speaking, much cheaper than wooden ones cannot be denied. This being agreed, then the question of its use cannot be ignored. Cheapness to-day is a tremendously important factor and it is regrettable to add that quality is hardly considered in the same light as in earlier days. Price is the chief factor, and now one has difficulty in persuading the customer that although the price is rather high he is recompensed by a better quality article. Those who might disagree with this statement need only go "on the road" for a week or two.

Examining the objections against plaster patterns *seriatim*, the following conclusions have been arrived at.

Easily Broken.

This can hardly be denied. If the pattern, however, is well made and properly reinforced it will generally stand up to what it was intended for. Baking has also much to do with the stability of the pattern, for an "under-baked" pattern will more easily break. Rough handling will, of course, break almost any plaster pattern, and it is up to the moulder to use a little consideration and not to blame the pattern for his own mis-handling. The writer has seen sturdy wood patterns almost knocked to pieces through clumsy handling. Surely the fault is not all on the other side?

Drawing the Pattern.

Here, one must agree that more finishing is required from a plaster pattern than from one made of wood or metal. But surely this is compensated for time and time over when one considers the saving in the pattern cost. Again, even this difficulty can be reduced to a minimum if a good mixing is used and afterwards well finished and baked. A good varnish (as thin as possible—similar in consistency to liquid veneer) will considerably improve matters. Always use new varnish and a perfectly clean brush, doing the work in a room having an even temperature of about 80 deg. Much depends on the success of the varnishing.

Provisions for Drawing the Pattern.

Such provisions can easily be made if a little thought and care are exercised when striking up the pattern. The writer has seen hundreds of plaster patterns delivered to the foundry without any provision whatever for drawing out of the mould.

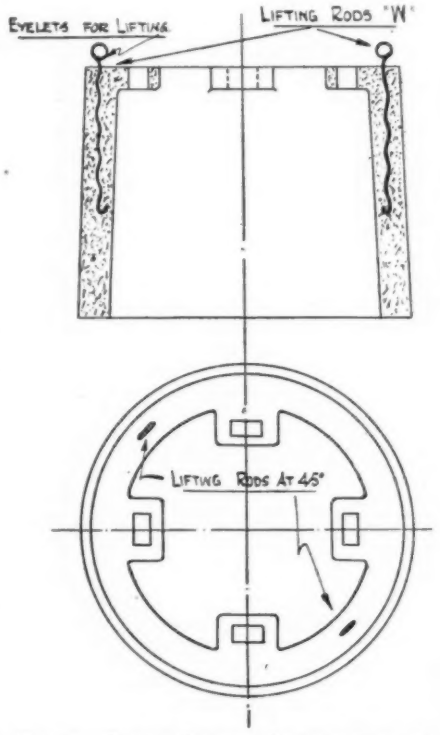

Fig. 1.—Simple Lifting Arrangement for Plaster Patterns.

Such instances as these can only be ascribed to the ignorance of the maker as to moulding requirements. If provision is not made in the first instance it is too late when the plaster pattern is finished. One cannot screw lifting plates or rings into plaster of paris. In Fig. 1 is shown a simple liner pattern with lifting arrangement. The rods W are about $\frac{3}{16}$ in. round, bent at one end to form an eye and raggled in the plaster itself. These rods (two in this particular example) are inserted in the plaster mould when in a semi-liquid state, provision being made for correctly setting the rods square and perpendicular with the liner body. It will be seen that it is impossible for the rods to come loose from the finished pattern unless, of course, the pattern is broken at that particular spot. Other similar provisions can be made without great difficulty in patterns of more intricate shape, and loose draw pieces are sometimes better made in wood instead of plaster. One cannot enunciate anything definite and it is up to the patternmaker, or plaster moulder should we say, to use discretion in his task.

Physical Characteristics.

A great deal depends on the mixing of the plaster if one desires the best results possible. Sometimes one finds that the plaster is not easy to "work," and sets too rapidly. Nothing is more disturbing than the latter, especially in the case of intricate-shaped patterns. A little glue added to the water in mixing will slow down the setting. On the other hand, a 10 per cent. (approximately) addition to the mixing of lime will hasten the setting. The latter will also harden the plaster. A most important factor is the baking of the pattern. This should be done very slowly and not in too great a heat. Quick drying weakens the pattern, and tends to render it more porous when subjected to working conditions. If, however, the drying is carried out efficiently, all moisture will be driven out, and a good coat of varnish afterwards will make the pattern able to withstand ordinary moisture. After use the pattern should be stored in a cool, dry place, as also should plaster of paris in its powder form, as few materials absorb moisture so easily.

Conclusions.

For jobbing foundries and "one-off" jobs, plaster of paris is certainly an advantage. Pattern costs can be lowered and competitive prices maintained. The writer is of the opinion that plaster patterns are not given the attention they deserve, and attributes the laxity to the inexperience of most patternmakers with this class of pattern. A visit to any good pottery or sanitary-pipe firm would convince many prejudiced minds of the usefulness of plaster of paris. Jobs have been won frequently chiefly through the reduction of initial pattern costs. Jobbing foundries cannot afford to ignore the use of plaster patterns. Inconvenient though it may seem, it might easily mean the difference between winning and losing a small job—and small jobs may lead to important orders.

In conclusion, it should be remembered that plaster of paris does not contract when setting, and thus a plaster pattern is exactly the same size as that from which it is made.

West Coast Ironworks Merger.

NORTH LONSDALE AND MILLOM ASKAM COMPANIES.

The shareholders of the North Lonsdale Iron & Steel Company, Limited, Ulverston, are informed that a provisional agreement has been arrived at between the company and the Millom & Askam Hematite Iron Company, Limited, for an amalgamation of interests.

The directors of the North Lonsdale Company state that they are satisfied that any amalgamation of the interests of these companies must be of great benefit to both, not only in the reduction of costs, but also in the reduction of competition and in other ways. Especially is it well known that the supplies of low-phosphorus and free-smelting local ore are being seriously reduced owing to various mines having been worked out, and as a result the North Lonsdale Iron & Steel Company, Limited, would, in a comparatively short time, have to rely to a still greater extent on the Ullcoats Mine and foreign ore. The Millom & Askam Hematite Iron Company, Limited, not only holds a larger interest in the Ullcoats Mine than the North Lonsdale Iron & Steel Company, Limited, but, in addition, also owns the adjoining Florence Mine and the Alquife mines in Spain, and, therefore, it is in a position to supplement beneficially the supply of local ores to the North Lonsdale Company's works. Under the terms of the agreement the Millom & Askam Company offer North Lonsdale shareholders shares in the Millom & Askam Company in exchange for their holdings. They offer in exchange for one-sixth of the North Lonsdale ordinary shares an equal number of 7 per cent. cumulative and participating preference shares, and for the other five-sixths of the North Lonsdale ordinary shares, three Millom & Askam ordinary shares for every four North Lonsdale shares. This means that in exchange for a shareholder's 300 shares in the North Lonsdale Company, the Millom & Askam Company offer 50 of their 7 per cent. preference, and 188 of their ordinary shares.

The Application of Pulverised Fuel to the Foundry Industry.*

By W. Boon (Consulting Engineer).

The subject of the application of pulverised fuel to the foundry industry has been divided into seven sub-headings. Each of these sub-headings is perhaps of sufficient importance to warrant their being the subject of one complete Paper, so that to take anything like a complete survey of pulverised-fuel applications such as the one under review will necessitate a very curtailed description of each of the seven sub-divisions.

The purpose of this Paper is not so much that it should be in the nature of a very detailed technical discussion, but that a general survey of the whole field should be given to enable the uninitiated to form some comprehensive and clear idea as to the elements entering into consideration of installations of this character.

The equipment which may be installed to fulfil any pulverised-fuel application is, of course, a matter of first importance, and could only be correctly based upon experience which would dictate not only the type of machinery to employ, but the method of its arrangement and also the necessary auxiliaries which go to form the whole.

Types of Pulverisers Available.

The first section deals with the various types of pulveriser, their advantages and disadvantages and the particular use of each type. The selection of the right type of grinding machinery is often a matter of some difficulty in view of the scores of different makes on the market to-day. To discuss the relative and individual merits of such a large number of machines is rather out of the question, and it is proposed to divide these machines into three main groups:—(1) The impact high-speed and attrition mills; (2) the ring-roll medium-speed grinders, and (3) the slow-speed ball and tube mills.

In the first category would fall such well-known machines as the Attritor, Resolutor, Simplex, Miracle, Bettington, Forplex, Kek, etc. In the ring-roll group would enter the Raymond, Rema, Fuller, Sturtevant, Bonnot, Bradley, etc., and in the last category would be included the Hardinge, Fuller Bonnot, Johnsons, Simon Carves, Krupp, etc. There are mills, of course, which also would come between these groups, for instance, a combination of the ball and impact mill would apply to two of the foregoing categories.

Group 1.—The high-speed mills coming under Group 1 have achieved a certain degree of popularity due to low initial cost as compared to the heavier type of grinders appearing in the remaining groups, and also the relatively low power consumption per ton of product. The reduction of material takes place in these mills by attrition and impact, and they usually consist of a central shaft which may be directly coupled to a motor, and to which is attached various sizes and shapes of grinding media, the whole enclosed in a metal-lined chamber, where the incoming material is shattered by a direct blow of the beaters and also by the impact of the material being hurled against the lining of the chamber, or again by direct shearing action.

Those depending more upon the shearing action effect, are constructed with one set of beater bars or pins stationary and the other revolving at a high speed. Other mills in this same group are constructed with rotating members operating in opposite directions.

Group 2.—Under the second group of mills the material is reduced and ruptured by compression, centrifugal force or spring pressure, or again a combination of these forces. In these mills the coal is definitely ground, that is to say, it passes between moving and stationary faces, which vary in construction in accordance with the various types.

Group 3.—In the third group the coal is reduced more by direct hammer blows, which is perhaps the best medium known for the reduction of material, being more effective than either attrition or grinding between the balls which form the charge. The ball mill is the slowest moving of any of the grinding machines, and is perhaps the oldest principle used for the reduction of material in use to-day. The ordinary hammer blow is the best method known to cause rupture and the ball mill makes more use of this principle than any other grinding machine. The mill is horizontal and the speed of the barrel is so arranged that the ball is lifted to a point near the top of the cylinder and its own weight will then permit it to drop on to the coal in the bottom of the barrel. A certain degree of grinding also takes place by the rumbling effect of the coal being mixed with the ball charge, but the greatest asset which gives the greatest production from this type of mill is undoubtedly due to the dropping or cascading of the balls from the top of the barrel.

In Group 1, the impact group, the coal produced is of a granular form and contains no large proportions of tailings, or, what the miller would term, "fine flour." Therefore, where the application is required for a furnace where the heat release is comparatively high, then the product from this class of mill would not be so satisfactory as that produced by the positive grinding mills. In addition to which, the high-speed mill must be guarded against the intrusion of foreign materials, such as tramp iron, and separating means have to be provided, usually externally to the mill, to prevent stray bolts or nuts getting into the machine with the coal, otherwise the beaters or hammers correspondingly suffer. Again, the grinding effect in the high-speed mills in this group is such that in the course of time, as wear takes place, the fineness of the product will suffer. Various external separators are provided in these mills, both internal and external, to offset this contingency, but, generally speaking, the falling-off in the fineness of the product is so severe after, say, 400 to 500 hrs. of operation, that the output of the mill has to be seriously curtailed, or, alternatively, a coarse product will be provided, which causes trouble in the furnace and would result in the fuel being partially unconsumed.

With regard to Group 2, where the grinding is positive and the rupture is due to compression, the falling-off in the fineness of the product is not nearly so marked as in the impact machines, but as wear does take place and as loss of weight in the grinding media occurs, the output of any given mill will have to be reduced in order to provide the same fineness which the mill originally was intended to produce. The same remarks given above with regard to tramp iron apply to this category of mill, although the damage, due to the lower speed of the mill operation, would not be nearly so severe as in the case of the high-speed units.

The initial cost of the ring-roll mill is, of course, considerably in excess of the impact machine, but it produces a product which is more reliable and more uniform than the impact type of machine. The power required for driving this class of pulveriser would be generally higher than would be the case under Group I, but the author's opinion is that the value of the uniformity in the coal supply would more than offset the additional power requirements. The maintenance costs, comparing either Group 1 or Group 2, may not be of great difference. In Group 3—ball mills—the power characteristics are perhaps higher than in the other two groups, for the simple reason that the ball mill is not a well-balanced machine; also, the ball-mill type of pulveriser has the disadvantage of comparatively high initial cost, but against these factors could be set the better grinding ability of the machine, a more uniform supply of product, and entire reliability, due principally to the slow speed at which this type of pulveriser operates. Its maintenance cost is undoubtedly the lowest of any type of grinding machine yet produced, neither does this mill require any auxiliary mechanism for the prevention of tramp iron or extraneous matter getting into the mill with the coal—in fact, any materials of this character which would pass the coal feeder would remain in the mill and continue to do some service in the way of reducing the material to be ground. The replacement costs of these mills simply depend upon the addition occasionally of more balls, which can be fed into the mill with the coal without stopping its operation or interrupting the service.

Power Consumption.

There has been much controversy and more writing about the power consumption of various pulverisers than one can well assimilate. Such comparisons are usually quite futile and can only appeal to the uninitiated. The comparison of power consumption, which, of course, is the highest item in the cost of producing pulverised fuel, between the different mills which are on the market to-day, can only be made under exactly similar conditions, that is to say, with the same product and for the same fineness. It is only commonsense to say that to pulverise any given material to a definite fineness must require the same amount of work to be expended in any machine. Differences in power, therefore, can only lie in the mechanical efficiency of the machine itself. It can be easily seen and freely admitted that the better balanced high-speed impact machine must have a better power characteristic than, say, the ball mill, which is a slow-speed moving cylinder and badly balanced. To illustrate this point further, the ball mill, with its charge, requires almost the same power to operate it when the mill is empty as when it is normally producing. The ring roll is also a better balanced machine than the cylinder of a ball mill, hence one may concede that it will have a better power consumption.

The advantages and disadvantages, therefore, of the particular types can be summarised in the fact that Group 1 may have a better power characteristic than Groups 2 and 3. Groups 2 and 3, however, produce a more uniform and finer product than Group 1. Maintenance charges in Groups 1 and 2 are considerably in excess of Group 3. Groups 2 and 3 are more reliable mills for long service than Group 1.

Fundamental Considerations.

The particular use to which each type should be put is a difficult question to answer, and rather than state the exact types of furnaces or boilers to which each group may be applied, it will suffice to say that this question is better decided by the heat release which a given application is required to undertake. That is to say, what is the B.Th.U. quantity to be consumed per cub. ft. of combustion volume per hour? This rate is a vital factor, and is unfortunately too frequently misunderstood or ignored when considering pulverised-fuel applications. Where the heat release is low, that is to say, a figure up to 30,000 B.Th.U. per cub. ft., then it is perfectly feasible to use the high-speed mills, providing that no other considerations would rule out this machine.

Where the heat liberation is beyond this figure, then better grinding is needed than can be provided in the impact machines. A golden rule to follow is the greater the heat release, the finer and more uniform the grinding. By uniformity is meant not so much that the pro-

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* Paper presented at a meeting of the London Branch of the Institute of British Foundrymen, Mr. H. C. Dews presiding.

duct should be exactly the same as regards size, but that there shall be no large proportion of over-size material produced. How much fine material is produced is immaterial, excepting that the fineness of the tailings or flour gives always better burning conditions, but it would be uneconomical and unnecessary to produce a wholly fine product. This point will be pursued somewhat further later, where a discussion as to types and characteristics of coal, fineness of grinding and effects of moisture is given.

Types and Characteristics of Coal.

It would perhaps be surprising to say that the characteristics of English coal vary enormously. They vary not only in their structure and their hardness and resistance to rupture, but in their physical properties. The type of coal which may be used in any given installation has a distinct bearing also on the type of mill which is to be employed. Take, for instance, bituminous coals. If one employs impact machines on Durham coal, which is exceedingly hard and tough to grind, the product would be so bad and the maintenance so high that new internals would have to be put into some of these types of mills perhaps after 300 working hours, or even less. At the other extreme, one could take a Kent coal, which is of a very friable character, and the same machine would easily last 1,000 hrs. without renewal of any beaters, yet the analyses of the two coals may be closely approximating. It is obvious, therefore, that where the harder coals exist, the impact type of pulveriser would be a very costly installation, notwithstanding its better power characteristics and its cheaper initial cost.

The fineness of grinding, and the decision as to what degree is necessary for any given application, is definitely ruled by the time necessary to burn completely any given particle, and therefore by the rate of combustion and the path and velocity of the particle. The actual rate of combustion of any fuel is determined by:—(1) The temperature of the combustion chamber; (2) the concentration of the mixture of air and fuel, with which may be included the intimacy of mixing and the effect of dilution by inerts, such as nitrogen and carbon dioxide; (3) turbulence, in so far as it results in the movement of the fuel particles relative to the oxygen molecules; and (4) chemical and physical properties of the fuel itself.

The higher the temperature, the higher is the speed of any chemical reaction, but as coal is a bad conductor of heat, a large lump of coal will take much longer to reach the temperature necessary for reaction than the same weight of small particles suspended in the heating medium. Further, considering only the surface effect, the small particles will have a greater ratio of air to weight than the large, and will therefore attain a high surface temperature much more readily. Quick ignition will not only be assisted by this, but also by the more rapid evolution of the volatile constituents of the coal. In the same way powdered fuel will also pass through the remaining phases of combustion more quickly than lump coal.

With regard to turbulence, solid fuel remains stationary on the grate, whereas finely-divided fuel would be capable of being whirled about the combustion chamber with any required degree of violence. The whole argument, therefore, of fineness resolves itself into the question of the time element. The shorter the time that is available for the consumption of a particle of coal, then the smaller must be its size. Therefore, where the degree of heat-release is comparatively high and the flame path is a short one, it becomes essential to have not only good fine grinding, but a uniform product. By this is meant the absence of any oversize. To burn a cube of coal measuring 3 centimetres along its edge, then the combustion of this cube, after being pulverised by grinding, will proceed 1,500 times quicker than the cube itself. A particle of coal through 170 mesh will have a size 0.02 c.c., so that the cube will contain, or by grinding be resolved into, 3,400 million dust particles. The original cube had a superficial area for the reception and emission of heat of only 54 sq. cm., whereas the total superficial area of the dust produced from it is 8,200 sq. cm., or 1,500 times as great.

An excellent specification for good grinding with the types of mills in Groups 2 and 3 would be no residue on 60 mesh, and it is certain that if this were maintained the resulting product would be suitable for nearly every metallurgical application, and it also would be an ideal fuel for boilers. It is the oversize which is the enemy of all pulverised-fuel burning, and if this can be taken care of, the fines will look after themselves.

Effect of Moisture.

The effect of moisture on coal has a very important bearing throughout the pulverised-fuel plant, and as most of English coals are highly hygroscopic, the moisture content is a point to which too much attention cannot be given. In the past, coal has been sold so easily per ton, or by the truck, under no definite specification, that the suppliers had a very pleasant time of it, putting as much water into the coal as it would possibly hold and selling that to the consumer as heat value. The coal factor is having an increasingly difficult time, as the coal consumer is more and more specifying his definite requirements with regard to the fuel, and is keeping a much closer scrutiny on the coal which is being delivered than he ever did in the past. This condition of affairs is exactly as it ought to be. Coal has been so cheap in the past that users have not minded very much if it did contain a great deal of foreign matter. The economies, however, which have to be practised in most industries to-day, coupled with the high price to which coal has climbed, necessitate a very much closer scrutiny of the coal purchased than ever was the case before.

The coal purchased for pulverising is frequently an unwashed product, and, as such, should be reasonably dry, that is, below 5 per cent. of moisture, particularly so when it is procured from a colliery whereby the transport time between the producer and the consumer is not very great. Washed coal would contain normally about 8 per cent. of moisture as delivered. This moisture content detracts from easy grinding; the higher the moisture in the fuel the more difficult becomes the grindability of the coal, because of the easily-understandable fact that the particles, after powdering, congeal together; in other words, ball up, so that the result of delivering such congealed particles into the furnace would considerably nullify its efficiency. Apart from the inefficiency of the furnace, the output of the grinding mill is considerably reduced, hence definite steps must be taken to deal with this factor, as and when it arises. Where pulverisers are directly connected to furnaces, the admission of hot air into the mill is sufficient to overcome the disabilities of the coal with regard to grinding, but under such circumstances the moisture-laden air is delivered into the furnace and has to be driven off at that point. It is therefore uneconomical to use a coal with a heavy moisture content if at all possible to avoid it, and in the case where coal is stored after pulverising, in a bin or hopper, it is imperative that this fuel should be as free as possible from moisture, and that the moisture-laden air in circuit in this bin should be effectively vented to atmosphere. Alternatively, the coal may be dried prior to pulverisation. The installation of drying equipment is, however, an expensive item, and should be obviated, if possible, by the purchase of a reasonably dry coal in the first instance. The collieries can supply dry coal, and will do so if the demand is sufficiently insistent.

English coal is surprisingly hygroscopic after pulverisation, much more so than the American coals. Ordinary Midland slack, after pulverisation, dry, will absorb, during 24 hrs., nearly 4 per cent. of moisture, whereas American coal of almost the same analysis will only take up in the same time 2 per cent., under natural air exposure.

Centralisation *versus* the Unit System.

Much has been written with regard to the claims for the so-called central or bin system, as opposed to the unit application. At the risk of going over old ground, it would perhaps be well clearly to indicate what the two types embrace. The unit system is understood to mean a pulveriser applied directly to a furnace or boiler, and without any intermediate storage of powdered coal between the pulveriser and the furnace it is serving.

The central system means a collection of pulverising machinery on one site, and the delivery of the pulverised product into storage bins or hoppers. From these storage bins the prepared coal is delivered to the various furnaces by means of feeders on the bin and methods for carrying the coal to the furnaces.

The consideration as to which type of equipment is to be used depends almost entirely on site conditions and methods of operation. Where one or two furnaces are to be applied, it would seem unnecessary to contemplate any other system than applying a single pulveriser to one or two furnaces. On the other hand, where a series of furnaces or boilers are in contemplation, then it may reasonably be assumed that a central system would be cheaper in capital cost, as one pulveriser could be used to provide the necessary coal into the bin, which may serve a multiplicity of furnaces. A pulveriser working in this way produces at its full output and has a better load factor than say a machine directly coupled to a furnace and which may have fluctuating coal requirements. In other words, a pulveriser applied to a single furnace would not have nearly such a good load factor as the one which is working steadily and at full capacity for the supply of a stock bin.

Another factor to be taken into consideration would be the distribution of the raw coal; presupposing that a number of furnaces were in operation and each furnace was supplied with its separate pulveriser, then the raw coal would have to be carried to those various points and each mill would have to be fed independently. In a central system, all the raw coal would be brought to one spot and fed into perhaps one mill. In other words, the unit system would necessitate carrying coal round the works premises, and the central system would obviate this entirely. In addition to which, the works would be very much the cleaner and would provide more useful working space if it were free from coal hoppers or machinery adjacent to the furnaces.

The comparison of capital cost between these two systems is a matter of simple arithmetic. In the case of two or three furnaces, it would probably be cheaper to install a unit machine to each. Beyond that number, the central system would probably be the cheaper installation. Apart, also, from these considerations, the fact that a stock bin containing prepared fuel is available, permits of continuous operation from this source without any definite reliance being placed on the continuity of operation of the pulveriser—that is to say, that a pulveriser on the central system can be started and stopped at any time without any interruption to the supply, providing only that storage is available in the bin when such a stoppage occurs.

On the other hand, any interruption in the running of the unit machine entails a stoppage of the furnace, and in the case of melting furnaces such a contingency would have grave results. Where conditions are such that furnaces are required to run continuously for 24 hrs. a day, it would be unwise to trust such a service as the unit application, and if, as is possible, standby machinery were installed, then

again the capital cost is beginning to assume such proportions that the central system would be the cheaper proposition. The mills in Groups 2 and 3 are definitely indicated for central systems, and the mills under Group 1 would not be feasible under this scheme, but for the unit system all three groups could be utilised.

Transporting Coal within the Works.

The question of transporting pulverised coal throughout a works premises, pre-supposing that a number of furnaces were to be fired and in widely scattered positions, would entail means depending upon operating conditions of each particular shop. For instance, one department of a works may conceivably be operating on day and night conditions, whereas other sections of the same works may only operate one single shift. Upon such considerations would depend the choice and class of equipment to be employed. It may be that if a central pulverising plant were installed for a series of widely scattered furnaces, the best policy would be to adopt sub-stations, or storage bins in separate departments and to serve these storage bins from the main station by either air transport of the fuel, or mechanical conveyance. The particular furnaces which each sub-station would deal with could be fed by a distributing pipe line or circulating system which would convey the fuel as a mechanical gas to the different furnaces from each main, tappings would be taken as and when required.

An instance of this would be an annealing shop with, say, a battery of ovens. The coal supply main would pass closely adjacent to these ovens, and tappings would be taken to each one individually by means of cut-off valve and pipe connections to the burner. Air would be the carrying medium, by pressure sufficient to convey the coal throughout the pipe main and to return back again to the storage bin whatever quantity had not been consumed at the furnaces. This means of serving a multiplicity of furnaces has been widely adopted, both in this country and on the Continent, and for this purpose no better or more reliable method has yet been devised. It is perfectly true, however, that the conveyance of coal by means of air through a long distance is an expensive item in power, and if a reasonably cheap mechanical means could be devised for this duty, then a distinct advance would be made. Continuous experiments are being carried out in this connection, and there is no doubt that ultimately a mechanical method will be produced which will uniformly serve a variety of furnaces and will offer a means of controlling the exact quantity of coal required at each individual burner.

The storing of pulverised coal in bins is a matter which is to-day comparatively simple. With the highly volatile coals it is essential, however, that reasonable precautions should be made to prevent spontaneous combustion. Bins should be provided so that all external air is excluded, and the moisture content of the coal being put into the bin should not exceed 5 per cent. as a maximum, otherwise the feed out of the bin becomes sticky and irregular. A low moisture content is particularly important when the coal has to be conveyed long distances through pipe lines.

Pulverised Fuel and Metallurgical Furnaces.

The data available of operating figures are rather sparse for the foundry industry, and whilst the author has a mass of figures available for forge furnaces, re-heating furnaces, etc., the foundry applications are more or less confined to malleable melting furnaces, chilled-roll melting furnaces, malleable annealing and core ovens, and curtailed results on rotary melting. With a malleable-iron air furnace, of which a considerable number are now working under pulverised-fuel conditions, and which seems to be an ideal application for pulverised fuel, the fuel to metal ratio varies from 2.5 to 1 to 3 to 1, using a raw fuel of the following approximate analysis:—Moisture, 8.2; volatile, 33.0; fixed carbon, 60.0; sulphur, 0.84; and ash, 7.0 per cent. The calorific value was 13,300 B.Th.U. and the fuel cost about 17s. per ton in the Midlands, whereas a similar furnace under hand-firing conditions would use best top hards costing in the region of 24s. per ton, and giving a fuel ratio under best conditions up to 2.25, with a melting speed of about 30 min. per ton, whereas under pulverised-fuel firing the melting speed is improved to 20 min. per ton.

Annealing Ovens.

With regard to annealing ovens, again on black-heart malleable, over a long period of time records have been taken on a battery of fifteen ovens, all pulverised-coal-fired. Each oven is of 25 tons capacity, and the average coal consumption gives a figure of 6 cwts. per ton of finished castings, and again using the same cheap coal as in the melting furnace. Under hand-firing, for the same furnaces and work, the coal consumption was 10 cwts. per ton of best top hards. In addition to which, the life of the annealing pans is increased to an average of 12 heats. In white-heart malleable annealing the consumption of coal would, of course, be relatively higher because the process is carried out at a higher temperature than is the case with black-heart, and also the castings are more firmly packed in the boxes to prevent distortion than is the case with black-heart, the temperature for the black-heart being 850 deg. C. and for the white-heart 980 deg. C. The fuel consumption under pulverised-coal firing per ton of finished castings for white-heart may reach 22 cwts., and the life of the annealing pans would not be in excess of 8 heats.

Some success has been achieved in the application of pulverised fuel to core ovens, but unfortunately no actual test figures are available. The net results, however, have been such that on a 25 per cent. fuel reduction, an increase in core output up to 50 per cent. from the same ovens has been achieved. The application is a comparatively simple one, the original flues being utilised with a simple type of burner projecting directly into the flue. Access, of course, must be available to flues of this character, because of the removal of the fine ash which accumulates. There is, however, usually ample opportunity and time for the removal of any accumulations.

Chilled-Roll Furnaces.

A considerable advance has also been made in the application of pulverised-fuel firing to chilled-roll melting furnaces. This trade, as is well known, is most conservative, and any innovations which may depart from standard practice have to be treated with some delicacy.

To an outsider, such as the author, the fabrication of chilled rolls always seems to be attended with a great deal of ceremony and ritual, and a certain amount of haphazard method which does not seem commensurate or in keeping with modern practice. Whether such a condition of affairs is justified, or whether there is more in the ritual than meets the eye, the author is not sufficient of a metallurgist to judge.

During six months of observation and tests on a 12-ton double reverberatory old-type melting furnace, which was converted from hand-firing to pulverised-fuel firing, the following interesting results were obtained:—

Normally, under the old conditions, this furnace consumed 1 ton of best top hards coal costing 24s. 6d. per ton of metal cast, and in the first week of operation under pulverised-fuel conditions, the best results gave 12 cwts. of Hollywood small slack costing 15s. 6d. per ton. The time both for bringing the furnace up to heat and for the melting period was reduced, and after a considerable number of tests were run, the following definite conclusions were reached:—

Heating time—that is, for bringing the furnace up from cold to charging—80 min.

With the fuel feed at about 33 lbs. of coal per min., the furnace was then reduced to a low coal feed during the time of charging, and the average charging time was 45 min.

The charge consisted of scrap, pig and large pieces of broken rolls.

The melting time was fixed at the rate of 23 min. per ton of metal charged and the fuel feed was fixed at 43 lbs. of coal per min.

After the first test-piece had been taken, the coal feed was reduced to 25 lbs. per min. until tapping, which period usually averages 50 min.

The fuel ratio in the various tests had varied more on account of the altering time, that is, after the first test-piece had been cast, than for any other consideration.

The fuel rate for bringing the furnace up to heat was constant, the melting period was also fairly constant, but the altering period was a variable, which caused considerable discrepancies from 12 to as high as 17 cwts. per ton of metal cast. As experience was gained in the stability of the combustion conditions, the altering period for the adjustment of the metal bath was slowly reduced, in other words, the operators began to rely upon the uniformity with which the elements were burnt out or changed due to combustion conditions, and a ratio from this furnace is now being obtained of 10 cwts. of this cheaper coal per ton of roll cast. In no instance, right from the commencement of the first melt, was a bad roll run, and it will be appreciated that time is the only factor which definitely proves the quality of a roll, six months has elapsed and there has been no single complaint about the quality of any roll.

Rotary Melting Furnaces.

The most recent development of pulverised-fuel applications and one which is probably of more interest to the foundry than any other, is the rotary melting furnace. Of this type, probably the Brackelsberg and Sesci are the best known, and have undoubtedly been the most successful, particularly the latter. There is to be presented some definite and detailed data on this subject at the meeting of January 21, but it would perhaps not be out of place to give some preliminary figures which have been achieved with the Sesci furnace.

A 5-ton charge for high-grade grey-iron castings was poured and completed in 2¼ hrs. working, starting from cold, and a second charge was poured in 1 hr. 50 min. The metal has a high degree of superheat and is normally much hotter than cupola-melted material. The furnace is making, in addition to high-grade iron castings, special pig-iron for sale to other foundries. This is somewhat in the nature of a distinct development, when the British foundry industry will have an opportunity of testing out special high-grade pig-iron cast in chills of British manufacture.

The following data are from the Terni Steelworks, in Italy, which are owned by Messrs. Vickers, and where armaments of all sorts are manufactured. Recently a Sesci 2-ton furnace was installed for experimental purposes. Their aim was to make locally, with steel scrap, synthetic iron which would replace hematite. To have effect steel had to be recarbonised above 3 per cent. The first charges were made up partly of steel and partly of hematite, but on the third day of working hematite was completely cut out and the charge was made up of 100 per cent. steel scrap. Recarbonising material was either petroleum coke (which gave the best results) or anthracite. The plant was run for a whole month, night and day, making synthetic iron only and casting it into pigs. The iron produced was to the following analysis:—Total carbon 3.2, silicon 1.3, manganese 0.6, sulphur 0.05 and phosphorus 0.05 per cent. This pig was transferred to the open-hearth furnaces and behaved in exactly the same way as hematite. A

test pouring from this iron, casting vertically in green sand, gave a tensile of 25 tons per sq. in.

The results of 5 weeks' operation were, apparently, so convincing and conclusive that the Terni Company placed a further order for three 10-ton Sesci furnaces. The importance of this development will at once be realised. Wherever steel scrap is available at a low price the rotary furnace offers the possibility of making locally synthetic irons of any reasonable analysis, depending only on the method employed for recarbonising. Recarbonising is now carried out so effectively at Terni that they can rely on an efficiency of 72 per cent. with petroleum coke, with a variation of only 1 per cent. With anthracite, the efficiency is between 63 and 65 per cent. This means that recarbonising can take place almost exactly at the point required, and, indeed, with far greater accuracy than a blast furnace can possibly do.

The melting cost at these works comes out at 10s. per ton all told, and the anthracite which is used is imported. The Sesci rotary furnace is, therefore, no longer to be considered as a furnace for producing high-grade iron or malleable-iron castings, but has definitely become an adjunct of large steelworks for melting scrap and transforming steel scrap into an iron ready for steel-making. The rotary furnace has also come to stay in the malleable-iron industry, and very impressive figures have been obtained from three separate Continental works, where operation has been of a sufficiently long period to warrant the results being quoted.

The fuel consumption has averaged 16.3 per cent. average over all the charges for a casting temperature above 1,600 deg. C., and allowing for tapping spread over 30 to 45 min., the actual fuel consumption for melting only is well below 14 per cent. Only 10 per cent. of the charge is hematite, and the remainder being foundry scrap and steel scrap. The heat is completed under 15 min. a ton from cold and 12 min. a ton on the second heat. The fuel used in the Sesci furnace is washed anthracite slacks, and the cost of material of this description of excellent analysis is about 16s. to 22s., depending upon the situation of the works from the source of supply. As one who has followed the development of the rotary furnace, it is the author's opinion that the Sesci furnace is an outstanding achievement in the process of metallurgical applications, and the foundry industry is to be congratulated on the developments and general improvements which have taken place in their methods and materials, perhaps more so than any other industry, in the metallurgical field.

Some interesting data on a rotary furnace operating at an important works on the Continent have been obtained. Most founders are anxious to have some reliable data concerning the cost of rotary furnace linings. The figures to be quoted have an added interest, because they have been verified by a Branch member, Mr. John Shaw, who is well known as an active and astute investigator.

This particular furnace has run for a considerable period of time and has consecutively done 130 heats before any lining renewal has taken place. Seventeen heats per week are taken from the furnace, and the total metal produced before any repairs have been undertaken has been 650 tons. The total quantity of refractory in the new furnace is 27 tons at a cost of £4 per ton; only $\frac{1}{14}$ of the total lining is, however, renewed each time. The cost, therefore, for material only on this base is 2.15s. per ton of metal cast, to which must be added labour. For this two men are required for two days breaking down and preparing the furnace, and four men are required for three days ramming up and finishing. A total equivalent to 16 day shifts at 10s. per shift, which gives an added cost for labour of 0.25s. per ton of metal cast, making a total, both for labour and material, of 2.40s., or, say, an outside figure of 2s. 6d.

Effect on Refractories.

The effect on furnace refractories of pulverised-fuel applications is generally that refractories have a longer life than under any other condition of firing, providing that reasonable precautions are taken in the introduction of the fuel into the furnace. Originally faults in pulverised-fuel applications were prolific in the fact that in the fuel and air stream entering the furnace the particles were allowed to scour or sweep the walls of the chamber. This condition naturally sets up erosion of the brickwork, which, however, was purely a mechanical condition and could easily have been overcome. To-day design, both of burners and air control, can permit of the flame's direction being regulated during the time the furnace is in operation, both as to length of flame and direction. A direct impingement of a stream of fuel on to refractories should at all times be avoided, as, naturally, brickwork will not last long under such severe conditions, but with well-designed furnaces and correct flame travel, the life of the brickwork in any type of furnace can be guaranteed to be much longer than would be the case under hand-fired conditions. The reason is fairly obvious; for one thing, the furnace is under more stable heat conditions; there is not the same fluctuation of temperature due to periods of cleaning fires or by excess quantities of air whereby stresses are set up in the brickwork. One of the chief factors that determine the life of the refractories is the velocity of the flame passing through the furnace; the secondary air, therefore, should not be admitted to even melting furnaces at a pressure exceeding 4 in., unless, of course, the burner is of such a type that a certain amount of additional pressure is necessary to overcome the resistance in it. Literally, hundreds of patents have been taken out on different types of burners for pulverised-fuel firing, 90 per cent. of which have been more or less futile. Experience is the teacher which dictates more than anything else the best type of burner to use for any given application, and one little incident which rather illustrates this is perhaps worth relating. A certain melting furnace fired by pulverised coal had been operating with flat fish-tail type burners, and a rotary type of burner was substituted at the insistence of a high-pressure salesman. The promises made were that the fuel saving would repay this installation in probably three months and that the furnace would in every respect operate better. The trial, however, was a very bitter disappointment, both to the salesman and also to his client. The burner lasted two weeks, during which time not one single melt was taken out of the furnace to the usual scheduled time. At the end of the two weeks the furnace crown had dropped in and the base of the stack had been severely damaged. The furnacemen were patient individuals, and lasted out the fortnight, certainly not without passing some very pertinent remarks about its operation, and during this fortnight of working the coal-consumption ratio was exceeded by 15 per cent., so that what was left of the burner was removed and the old fish tails were put back again. To propose a rotary burner for the condition requiring a long flame was, in the first place, quite wrong, as the flame spread, and the scouring action of the particles which were thrown out against the sides and roof of the furnace was quite against a long life of the refractories.

Effect of Ash.

Ash and slag formed in pulverised-fuel furnaces is deposited in a variety of ways, and, of course, is greatly dependent upon the original characteristics of the ash content in the coal and of the furnace design. Generally, the deposit falls into the following categories:—(1) Viscous liquid slag on the hottest part of the furnace walls, usually formed at a temperature of about 1,200 deg. C.; (2) as a partially sintered accumulation on the walls of the furnace, the friability of which depends on the temperature of the deposit, which ranges from 1,000 to 1,300 deg. C.; (3) as a deposit of the large ash particles from the floor of the combustion chamber which have solidified before touching any brickwork. For the ash to be deposited in a powdered condition the maximum temperature of the furnace walls seems to be about 900 to 1,000 deg. C.; and (4) smaller ash particles carried along by the draft and deposited in various parts of the flue system according to the relation between the gas velocity and the size of particle.

The average diameter of the particles taken from the floor of a combustion chamber in a particular test case was in the region of 100 microns. The surface of the larger particles are found, on examination under the microscope, to be covered with small particles having diameters between 1 and 6 microns, which would appear to indicate that these larger particles are built up from a multitude of small ones. The average diameter of the coal particles burnt in the furnace is about 10 microns, and assuming 15 per cent. of ash the calculated diameter of the resulting ash particle is 4.2 microns. The number of these small particles required to build up one particle of 100 microns is between 30,000 and 50,000, and this figure gives some idea of the turbulence which must exist in the combustion chamber of a furnace. The diameter of the largest coal particle is about 180 microns, so that it is unlikely that any ash particle having a diameter greater than 75 microns will be formed from a single coal particle.

Measurements on a sample taken from a dust collector gave a mean statistical diameter of about 8.2 microns, the largest solid particles having a diameter of 120 microns. In addition to the solid particles there are a number which are hollow and are in fact bubbles of silica. It is suggested that these bubbles are formed by the expansion of the gases from the particles of coke enclosed in molten ash. The slag removed, of course, from the molten iron is dark grey in colour and very heavy, due to the large quantity of iron oxide which has united with the silica. The temperature of deposition is between 1,400 and 1,700 deg. C., depending again upon the composition of the ash. Where the temperature of the refractory walls of the furnace or the combustion chamber is slightly below the fusion point of the ash, the liquid particles of slag impinge and collect on the walls, roof and floor of the furnaces. This slag eats into the brickwork and forms a coating which it is impossible to remove without damage to the refractories. The temperature of deposition varies around 1,200 deg. C. and upwards.

The liquid particles of ash have almost solidified before they impinge on the walls, but are just hot enough to sinter together before they touch. The deposit has the appearance of plant-like growths, and is very friable and may be crushed between the fingers. The temperature of its deposition is between 1,000 and 1,300 deg. C. The effect of ash generally is undoubtedly detrimental, whether the furnace operation may be in the form of pulverised-fuel firing or otherwise, and consequently all fuel applications are tremendously improved with the reduction in ash content of the original coal. It is a matter of economics, however, what coal shall be used on any particular installation, and it is being realised perhaps more to-day than ever before, that it is frequently cheaper to buy a dearer coal. Particularly so is this applicable in pulverised-fuel plant, where grinding costs have to be faced, because not only is power expended on the grinding of useless ash, but ash forms the hardest part of the coal which has to be ground, and consequently wear on the grinding media is more consequent upon ash content than upon any other state of the coal.

If, therefore, the ash content is reduced, the grinding cost per ton of coal is commensurately better. The production costs of pulverised coal

(*Concluded on page* 291.)

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 214.)

No. 9. LEARNING FROM COMPETITORS.

It is surprising how little certain sales managers know of what their competitors are doing. What they do know has reached them accidentally and has not been sought for; much of it is casual gossip. They know the names of their largest competitors, what they manufacture, and perhaps just a little about the way they sell. But in general no attempt is made to classify and organise this information. In theory, and in practice as far as possible, everything of sales importance should be known about the competitor, *e.g.*, how big he is, what his output is or can be, what he makes, how he buys and sells, what he charges.

Sources of Information.

Now, whence is this information to be obtained? The first and most obvious source is the competitor's catalogue. An indexed and complete file of competitors' catalogues should be an essential possession of every sales department. Most competitors give in their publications general information about the type of castings they produce, the steels or alloys they recommend for specific jobs, the methods they employ in manufacture. Illustrations indicate often the type of finish given. From these catalogues can be had data in regard to the terms of payment, type and character of plant and so forth. A collection of competitive castings, though not easy to obtain, is another useful thing, especially to production departments. It often enables the manufacturer to decide whether a certain part is being ground or machined, which may influence his own manufacturing and costing methods.

The next source of information is the customer. Many customers are also from time to time customers of the competitor, in emergencies, or in contra account, or as a matter of general policy. From them can be had information regarding the sales methods of the competitor, the quality and advantages of his castings, and the reasons why he gets particular orders.

The third source is the sales-promotion department. Certain firms have departments which furnish and collect from trade journals and other sources information in regard to the competitor and his activities. These departments are called sales-promotion departments, and will be dealt with later on in this series. Their other sources include blue books, Chambers of Commerce, the market departments of technical magazines, and so on.

Lastly comes the competitor himself. The old days of absolute secrecy are dying. Once upon a time no foundry would have given to a competitor even the name of its humblest office boy. To-day, it will take the competitor for a walk through its shops. Some firms make a point of frankly writing for any information they want, and offer to answer questions in return. After all, there is no reason why one should not ask openly. It is more straightforward, and if the offer of counter-information is sincere, no offence need be taken. It is much better in the long run than the roundabout method of indirect questioning.

Type of Information Desirable.

Now, let us be a little more specific and ascertain or, rather, indicate, what type of information about the customer is useful, and what is not. First of all, one must set down his source of supply for raw materials. That is important for many reasons. In the first place it opens up questions. Is it a better source? A cheaper source? Has he a monopoly of it? Secondly, it indicates advantages or disadvantages of the competing castings inherent in their very composition.

Then one must include special methods of manufacturing, which may be adaptable to one's own organisation. Thirdly, any special features of the competitor's delivery methods and facilities. If, for example, he uses the roads for the larger part of his traffic, is he economically justified in so doing? What are his reasons? Would it pay to copy him in this respect?

Next, there is the type of finish given to the castings, the extra touches or the touches lacking, the difference they make to the selling price. the possibility of obtaining them by better methods. After that, his methods of advertising demand study. In his advertising in better hands? Does he use different media? If so, are these media better than others? What points does he bring out about his castings? Does he mention competitors in a way that lays him open to contradiction or attack? Again, some information on the patent rights he holds is useful. Has he kept up his patents? How far do they go? What do they cover? Can they be got round legitimately?

These things disposed of, one comes to a fundamental, which is price. What part does price pay in selling his castings? If it is a higher price, why does he still get orders? And *vice versa*. Then follow the points of what discounts are given for resale, if any; whether packing is included or not; whether terms are net cash or monthly account less 2½ per cent. The next important point is the size of the competitor. What advantages does his larger (smaller) size give him? Does it make it easier for him to distribute, to manufacture, to produce a particular line? Generally, the methods of a competitor equal or approximately equal in size to oneself are the most easy to adapt, and throw the most light on one's own. Size for the founder is always an advantage so long as the market is big enough to absorb the overhead. It means that he can carry larger stocks of raw materials (which means he can usually buy them cheaper); he can afford, when necessary, to stock castings for his customer (with proper safeguards); he can offer greater advantages to his customers; he can turn over his goods more quickly as the volume of business increases; and he can advertise on a bigger scale.

Next, one must study the situation of the competitor's works in relation to its market and its raw materials. In succession, after this, come the type of castings competing, the number of competitors, the type of labour employed, the methods of transport adopted, the goodwill of trade-marks and brand names; the goodwill of the competitor himself; and the type of staff and management he possesses.

Foreign Competition.

In this connection one must pay special attention to foreign competition, from two points of view: (1) the competition of foreign goods with goods in this country; (2) the competition of our castings with foreign castings in other countries. It is possible that the home castings are directly threatened by some cheaper, foreign-made type. This has often happened, as when cheap labour and materials enabled the Belgian founders to capture part of the South African steel-castings market. The sales manager must take note of foreign competition if only as a protection. He should observe what other countries are doing in the foreign field, both aggressively and defensively. He should also study the tariff laws and other legislation pertaining to the subject.

In this difficult and important section of the sales-manager's work—the study of competition—he will have need for all his powers of judgment. It is not by any means easy to set a true value on competition. Nevertheless, he should find it possible to determine the basis of competition on which his company operates. In other words, he should be able to find out precisely why the company is better or worse off than its rivals. He should also obtain a pretty comprehensive notion of the strength of competition with which the foundry must contend, and how much effort will be needed to overcome it. Most important of all, the sales manager must be capable of recommending and carrying through some radical alteration in methods, wherever his analysis may show it to be essential.

Whatever conclusions the sales manager may reach, he must bear in mind that nowhere is tact more necessary than in mentioning competitors. Many managers of departments, particularly of production departments, have a direct antagonism towards their rivals which may make them tend to oppose on sheer principle or through prejudice any adoption of methods found by the latter to be successful. The sales manager will have to embody his suggestions, drawn from a study of his competitors, in such a way as to make them stand on their own basis as logical and demonstrably advantageous improvements in method.

(*To be continued.*)

Czech Foundry Equipment Brochure.

In connection with the recent Czecho-Slovakian Foundry Congress, each visitor was presented with an "Almanack," some of which were printed in German and others in Bohemian. The German edition runs to 124 pages and is particularly well illustrated. The object of this almanack is to reveal to the local foundry owners just what raw materials and plant they can buy nationally. It is obvious that they are dependent to some degree on imports, especially for moulding machines, conveyors and a few other modern machines, but for raw materials they are largely self-supporting. We congratulate the Czechs on the enterprise they have shown, and if they pursue the same initiative in connection with the International Foundry Congress they propose staging in 1934, the conference will undoubtedly be highly successful.

The Application of Pulverised Fuel to the Foundry Industry.

(*Concluded from page* 290.)

depend chiefly upon the power consumption and price paid for such power. Taking an example of a ball mill from actual practice, working on Midland bituminous coal, the figures for a 10-ton capacity machine are:—

Depreciation and interest	1.68d.
Maintenance	0.85d.
Labour	0.70d.
Power, 12 kw. at 0.5d. per kw.	6.00d.
	9.23d. for pulverising per ton of coal produced.

In conclusion, there are now over 400 metallurgical installations operating successfully with pulverised coal in this country and Europe alone, many of which plants are of large size and which have been extended from initial small beginnings. Thus continued progress has been made in this field, in spite of the general industrial depression.

THE FIRST TURBO-ELECTRIC SHIP to be built on the Tyne, the "Monarch of Bermuda" (20,500 gross tons) left the river yesterday in order to undergo trials. The vessel has been built by Messrs. Vickers-Armstrongs, Limited, for the Furness Withy Line.

This Week's News in Brief.

Trade Talk.

Crane-Bennett, Limited, yesterday opened new exhibit rooms at 120, Pall Mall, London, S.W.1.

Two sheet mills have been restarted at the South Durham Steelworks, West Hartlepool, as a result of foreign orders.

Harland & Wolff, Limited, Govan, have secured a contract from the L.M.S. Railway to build a sister ship to the pleasure steamer "Duchess of Montrose."

Messrs. Alexander Stephen & Sons, Limited, Govan, have received an order from French owners for a cargo vessel of between 7,000 and 8,000 tons deadweight.

Messrs. John Summers & Sons, Limited, Shotton, are making preparations to start up their steel plant. By so doing they will find employment for 1,000 to 2,000 men.

Armstrong, Whitworth & Company (Engineers), Limited, have just completed at Scotswood Works a new Diesel-electric rail car, the first of a consignment for South America.

The Ashburnham Tinplate Works, Burry Port, and the Kidwelly Tinplate Works, Kidwelly, resumed operations in full on November 2.

Messrs. Thos. E. Gray & Company, Limited, of 119, High Holborn, London, W.C.1, have received an order for 16 Zimmermann moulding machines for a foundry in the North Midlands.

Messrs. George Clark, Limited, Sunderland, are to start work on the engines for two vessels under construction by the Furness Shipbuilding Company, Limited, Haverton Hill-on-Tees.

The British (Guest Keen Baldwins) Iron & Steel Company, Limited, have brought a second blast furnace into operation at Port Talbot, and are preparing to restart a furnace at Cardiff.

The 2,000 employees of Platt Bros. & Company, Limited, textile-machinery manufacturers, Oldham, are now working on full time. For the past two years they have worked alternate weeks only.

Messrs. William Gray & Company, Limited, West Hartlepool, have received a repeat order for a steamer of 1,100 tons from Messrs. J. & C. Harrison, of London. This is the fifth order Messrs. Gray have received in the last four months.

The Great Western Railway Company has placed a contract with Messrs. Cowans, Sheldon & Company, Limited, Carlisle, for the erection of two 3-ton electric portable level-luffing jib cranes and grabs at Riverside Wharf, Brentford Docks.

The Council of the Senate of Cambridge University recommend that the Goldsmiths' Readership in Metallurgy be discontinued and that a Goldsmiths' Professorship in Metallurgy be established. The Goldsmiths' Company have assented to the proposal.

Ardrossan Dockyard, Limited, after being idle for about a year, will open their yard to build a paddle steamer for McKie & Baxter, Limited, Paisley. The vessel is for river service abroad, and will be fitted with compound engines built by McKie & Baxter, Limited.

Wm. M'Phail & Sons, Violet Grove Foundry, Glasgow, N.W., have recently established a branch foundry at 251, East Second Avenue, Vancouver, under the supervision of Mr. Robert M'Phail. The specialities to be covered embrace non-ferrous castings for the marine-engineering industry.

The first consignment of goods for the Hungarian State Railways, made, at a cost of £500,000, by the Metropolitan-Vickers Electrical Company, Limited, left Trafford Park in L.N.E.R. wagons last week. The goods include motors, control gear, and sub-station equipment, and this first consignment weighs 1,382 tons.

The Ulster Government, in an endeavour to encourage new industries in Ulster, is prepared to grant free sites to manufacturers not already established in the Province. They are urging Ulster municipalities to excuse rates for some years to give the new industries every opportunity to gain a sure footing.

Scott's Shipbuilding & Engineering Company, Limited, Greenock, have launched, for the China Navigation Company, London, the vessel "Shenking," which is 300 ft. long, with a gross tonnage of 3,000. The hull has been built on special lines and arranged for navigating through ice on the Haiho River. The propelling machinery consists of a set of single-reduction geared turbines.

Messrs. Guest, Keen & Nettlefolds, Limited, Castle Works, Rogerstone, Newport, announce that Mr. Cadby, who has been their Midlands representative for many years, has retired, and in his place they have appointed Mr. C. A. Parson, 111, New Street, Birmingham, who already represents their Darlaston Bolt & Nut Works, and their allied companies, Messrs. Joseph Sankey & Sons, Limited, Bilston, and Messrs. John Garrington & Sons, Limited, Darlaston.

In response to its appeal for information in regard to available factories and factory sites in Great Britain, the London Chamber of Commerce has received more than a thousand replies giving particulars of facilities which could be utilised for the establishment of new industries. The industries covered by the inquiries received include heavy machinery, galvanised wire, electrical apparatus, barbed wire, engineering, chain fencing, wire netting, rivets, screws and nails.

The United Strip & Bar Mills of the United Steel Companies, Limited, received on the morning of Tuesday, October 20, an urgent order for 375 tons of steel bars. The mill commenced work on this order at 11.20 a.m. that morning; at 11.10 p.m. the same day the rolling was completed; by 1.40 a.m. on Wednesday the whole of the material had been inspected, tested and loaded, and it was delivered to a destination 76 miles distant by 5.40 a.m., 18 hours from the commencement of work.

A message from Basle states that an international aluminium cartel was formed there on October 21 under the name of the Alliance Aluminium Compagnie A.-G., with a share capital of 35,000,000 Swiss francs, and a proviso that the capital may be increased, if necessary, to 65,000,000 Swiss francs. The company has been founded by French, British, German, Swiss and Canadian aluminium producers. A few Norwegian manufacturers associated with these producers are also included.

A big programme of improvements and developments to be undertaken by the London & North-Eastern Railway Company this winter includes widening the main line for 30 miles between York and Northallerton. At Mottram, near Manchester, a new yard for marshalling the coal trains between Lancashire and Yorkshire is to be built. At Whitemoor, in East Anglia, the L.N.E.R. is to construct a second series of marshalling sidings, holding 4,000 wagons, for sorting coal and freight trains to and from Yorkshire, the North-East and the South.

Mr. Sam Mavor, in a Paper, "Time Study in Engineering," read on October 27 before the Institution of Engineers and Shipbuilders in Scotland, said that the object of systems of payment by results was to reduce costs of production by offering to the workman opportunity and inducement to increase his output and enhance his earnings; but the adoption of such a system in the hope of reducing costs, without an accurate method of fixing rates, without full regard to the interests of the workman, and without readiness to pay adequately for increased output, would fail in its purpose, and it might increase costs, or stabilise and perpetuate costs which were already too high. If costs were too high because of defective workshop organisation, the last thing to do was to adopt payment by results; the first was to attack the problem of wasted time. After the causes of avoidable losses of time had been abolished by improved organisation and co-ordination—not till then—the management might turn to payment by results with hope of further betterment.

B.S. Specification for Phosphor Bronze Castings for Gear Blanks.—A specification providing for the chemical composition and physical properties of phosphor-bronze castings for gear blanks has been issued by the British Engineering Standards Association. Tensile tests and Brinell hardness tests are specified, whilst general clauses dealing with testing facilities and the freedom of the castings from defects are included. Copies of this specification (B.S.S. No. 421-1931) may be obtained from the Publications Department of the Association, 28, Victoria Street, S.W.1. Price 2s. 2d. post free.

Personal.

Mr. A. Leggett has been appointed a director and chairman of E. R. & F. Turner, Limited, Ipswich, in succession to the late Mr. Pierson Turner.

Mr. J. H. B. Forster and Mr. Ralph Freeman have joined the boards of the South Durham Steel & Iron Company, Limited, and the Cargo Fleet Iron Company, Limited.

Mr. James Affleck, B.Sc., formerly foundry manager at G. & J. Weir, Limited, Cathcart, has been appointed manager of Foundry Plant & Machinery, Limited, Glasgow.

Sir Felix J. C. Pole was last last week appointed chairman of Metropolitan-Vickers Electrical Company, Limited. Mr. W. C. Lusk was appointed deputy-chairman and Mr. P. S. Turner sales director. Mr. H. C. Pierson was elected to the board.

Wills.

Rogerson, T. W., ironfounder, of Baildon	£12,220
Hodgson, I. A., of I. A. Hodgson & Company, Limited, tinplate workers, Newcastle-upon-Tyne	£24,343
Brown, J., chairman and managing director of John Brown & Sons (Halesowen), Limited, tool manufacturers	£13,001

Obituary.

Sir Joseph Calvert, the Tees-side colliery owner, who last year put before the Ministry of Labour a scheme to alleviate unemployment in the iron and steel industry, died last Saturday, aged 78 years. He was at one time commercial manager of the mineral department of Bolckow, Vaughan & Company, Limited.

Contracts Open.

Bearstone, Nantwich, November 12.—5,695 tons of 15-in. to 2-in. dia. cast-iron pipes, with specials, lead service pipe, and various fittings, for the Nantwich Rural District Council. Mr. H. Crabtree, 21, Pillory Street, Nantwich. (Fee £2 2s., returnable.)

Bearstone, Nantwich, November 12.—Pumping plant, for the Rural District Council. Mr. H. Crabtree, 21, Pillory Street, Nantwich.

Dublin, November 17.—Iron and steel stores, for the Great Northern Railway (Ireland). Mr. F. C. Wallace, secretary, Amiens Street Station, Dublin. (Fee 1s.)

Hampton, Middlesex, November 24.—Pumping plant, for the Metropolitan Water Board. The offices of the Board, Chief Engineer's Department (Room 173), 173, Rosebery Avenue, London, E.C.1. (Fee £2 2s., returnable.)

Llandudas and Rhyd-y-Foel, November 19.—9,100 yds. spun-iron pipes, 6 in., 4 in. and 3 in. int. dia., for the St. Asaph (Denbigh) Rural District Council. Mr. C. F. Farrington, Trinity Square, Llandudno. (Fee £5 5s., returnable.)

Reports and Dividends.

Stanton Ironworks Company, Limited.—Interim dividend on the ordinary shares of 4 per cent. tax free.

Glenfield & Kennedy, Limited.—The mid-term dividend on the ordinary capital is maintained at 4 per cent., less tax.

John Lysaght, Limited.—Credit balance, £144,751; brought in, £338,652; dividend of 5 per cent., tax free, on the ordinary shares.

Samuel Osborn & Company, Limited.—Profit, £2,461; brought in, £21,974; carried forward, after payment of dividends on the preference shares, £10,069.

Hughes-Johnson Stampings, Limited.—Net profit, £7,478; brought in, £7,621; pension fund, £250; final dividend of 5 per cent., making 10 per cent. for the year; carried forward, £6,843.

John I. Thornycroft & Company, Limited.—Dividend of 3 per cent. on the preference shares, making the full 6 per cent. for the year. No dividend on the preferred ordinary or on the ordinary shares.

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Raw Material Markets.

Business in the iron and steel trades continues to expand steadily, and the National Government's overwhelming victory at the polls has brought a feeling of increased confidence into industry. New business in pig-iron has recently been on a smaller scale, due to the fact that many large consumers have arranged for supplies until the end of the year, but there has been a welcome increase in deliveries into consumption.

Pig-Iron.

MIDDLESBROUGH.—The demand for pig-iron is steadily improving, and the majority of the makers have sold their output to the end of the year. There has been no increase in prices yet, as the producers are anxious to get their idle plant back to work. There has been a gratifying increase in iron shipments from the Tees, and Cleveland iron has also been more successful against Continental competition in the Scottish market. Prices are unchanged. No. 1 Cleveland foundry iron is at 61s. per ton, No. 3 Cleveland G.M.B. at 58s. 6d., No. 4 foundry at 57s. 6d. and No. 4 forge at 57s. per ton.

There has been a steady demand for hematite on the East Coast market, although most of the large consumers have satisfied their needs for the moment. Makers' stocks continue to decrease, despite the rather fuller production. Prices remain the same to the end of the year. The West Coast hematite market was quieter during Election week, but there are already signs of an increasing activity, although many consumers will not be on the market again for some weeks; some, indeed, have fixed contracts to the end of the year.

LANCASHIRE.—The month of October was marked by heavier deliveries to foundries for consumption, although those engaged in making heavy products are still in a depressed state. There has recently been more activity in the textile trades, with a resultant increase in the demand for iron for making textile machinery. Prices remain steady. For delivery to users in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron are quoted at 67s. per ton, with Northamptonshire foundry iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at about 87s. and West Coast hematite iron at about 81s. per ton.

MIDLANDS.—New business remains steady, although on a smaller scale. The blast furnaces that are at present working are in a satisfactory position, as stocks have had to be drawn on in some cases to meet calls for delivery into consumption, chiefly to the light-castings foundries. There is no alteration in prices. For delivery to Birmingham and Black Country stations, makers continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Business in the Scottish pig-iron market has slackened down somewhat, although the general tone remains good. Continental iron varies in price, but is generally non-competitive. The official price of Scottish No. 3 foundry iron remains at 69s. 6d., although one producer has intimated an advance of 2s. 6d. Cleveland No. 3 remains at 62s. 6d. per ton f.o.t. Grangemouth.

Coke.

The Cleveland coke market is decidedly stronger and 17s. 6d. per ton is asked for good Durham furnace qualities, delivered works, as there is a distinct possibility of more furnaces being blown in shortly. In the Yorkshire area there is also an improved demand for furnace coke, but prices remain low. Foundry coke generally meets with a quiet sale in all districts.

Steel.

The position of the finished-steel works is still unsatisfactory, new business remaining scarce. More orders, however, are being received for small steel bars, owing to the difficulties of buying from the Continental producers. Black sheets are maintained at the increased prices, but the demand has as yet shown no sign of expansion. In the semis market, a considerable number of new orders is being gained from Continental producers by the home works.

Scrap.

In the Cleveland district, heavy steel scrap is meeting with a ready sale at 37s. 6d., and the price has been raised to 40s. in some cases. Light castings are also stronger, the present quotation being 33s. 6d. The recent improvement in the Midlands market is strongly maintained. Present prices are regarded as low, and consumers are inclined to buy forward. Good heavy machinery scrap in cupola sizes is at 47s. 6d. to 50s., while 37s. 6d. to 40s. delivered is being paid for large parcels of light cast-iron scrap. There has been a slight expansion of demand in the Welsh and Scottish markets.

Metals.

Copper.—There was not much demand here for electro copper last week, what business there was being transacted with "outside" interests, at a price a little below that of Copper Exporters, Inc., whose price remains at 7.50 cents c.i.f. Europe. There seems to be little definite news with regard to the producers' conference now being held, and the optimism it called forth may be unjustified. American industrialists would be unwilling to increase unemployment at the present moment.

Closing quotations :—

Cash.—Thursday, £35 15s. to £35 16s. 3d.; Friday, £35 to £35 1s. 3d.; Monday, £35 7s. 6d. to £35 10s.; Tuesday, £36 2s. 6d. to £36 5s.; Wednesday, £35 13s. 9d. to £35 16s. 3d.

Three Months.—Thursday, £36 10s. to £36 12s. 6d.; Friday, £35 10s. to £35 12s. 6d.; Monday, £36 1s. 3d. to £36 3s. 9d.; Tuesday, £36 17s. 6d. to £37; Wednesday, £36 6s. 3d. to £36 7s. 6d.

Tin.—Stocks of tin remain very large, while there has been no appreciable expansion in the demand, either in this country or in America. There seem to be no grounds for any increase in price.

Official closing prices :—

Cash.—Thursday, £126 12s. 6d. to £126 17s. 6d.; Friday, £127 2s. 6d. to £127 5s.; Monday, £127 7s. 6d. to £127 12s. 6d.; Tuesday, £129 5s. to £129 10s.; Wednesday, £128 2s. 6d. to £128 5s.

Three Months.—Thursday, £129 2s. 6d. to £129 5s.; Friday, £129 10s. to £129 12s. 6d.; Monday, £129 12s. 6d. to £129 15s.; Tuesday, £131 5s. to £131 10s.; Wednesday, £130 2s. 6d. to £130 5s.

Spelter.—Consumers in the spelter industry have been buying larger quantities than for some months, although the demand is still below normal. Production is to be cut down by a further 5 per cent., but supplies remain on a large scale.

Daily fluctuations :—

Ordinary.—Thursday, £13 6s. 3d.; Friday, £13 2s. 6d.; Monday, £13 7s. 6d.; Tuesday, £13 8s. 9d.; Wednesday, £13 3s. 9d.

Lead.—The demand for lead continues to be steady, although on a reduced scale. Sales on the Continent have recently shown a slight decline, due, it is reported, to the diversion of orders to this country.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £13 8s. 9d.; Friday, £13 8s. 9d.; Monday, £13 10s.; Tuesday, £13 15s.; Wednesday, £13 11s. 3d.

Russian Magnesite.—According to an estimate of the Russian technologist, S. Sauerteig, of Moscow, the magnesite deposits in the Urals contain some 40 million tons of mineral, as compared with the 100 million tons accepted as the extent of the reserves in Austria. Far more important, however, are the deposits in Manchuria, which have hardly been touched as yet, and which are estimated to contain enormous quantities of the mineral. In the past two years some 150,000 tons a year of magnesite have been produced in Russia, a figure approximately one-seventh of the total world's production. Actual figures for 1929-30 are as follow, the corresponding figures for 1928-29 being in parenthesis: Russian production of caustic magnesite, 6,227 tons (5,873 tons); Russian production of pulverised magnesite, 63,570 tons (54,260 tons); Russian production of brick magnesite, 34,450 tons (29,320 tons); and Russian exports of magnesite, 22,312 tons (16,411 tons).—"Chemical Trade Journal."

Students' Corner.

(*Continued from page 231.*)

Q.—Is the cupola the common melting unit in the iron foundry?

A.—In the grey-iron foundry it is, although it is possible to melt small quantities of grey iron in a coke-fired pot furnace or an oil-fired crucible furnace, and large quantities in an open-hearth air (coal-fired) or gas-fired furnace and also in the electric furnace. The cupola, on the whole, has been found the most convenient, and although as a melting unit it is only 25 per cent. efficient, it is still the most economical method at present for melting grey iron for general castings.

Q.—Whence does the cupola derive its name, and is the name of its inventor known?

A.—It is not very clear how the cupola derives its name. It may be from its shape and contour, as the early cupolas were probably dome-shaped, or an arched roof. It may, however, be a derivation from the word "cupel," which is a refining vessel. The names usually credited for the invention of the cupola are William Wilkinson or John Wilkinson, two brothers. The cupola is most probably an offshoot from the early blast furnace, and is a simple adaptation from that source to remelt pig-iron and scrap iron.

Q.—How is an ordinary cupola constructed?

A.—A brief description is as follows—An ordinary cupola is a straight, or nearly straight, shaft, of a predetermined diameter according to requirements. When building a cupola some factors to determine are—(1) What quantity of iron melted per hr. or day is required? (2) Whether the cupola is for continuous, daily, part daily, or occasional melting? (3) Are large quantities required to be tapped at one time? The shell of the cupola is chiefly made of wrought iron or mild steel. In the past an old boiler was often used for the purpose. The thickness may be $\frac{1}{8}$ to $\frac{1}{4}$ in. thick (according to diameter). The breast plate (if solid bottom), tapping holes, and charging door are cut out and strengthened. A strong flange of angle iron is riveted on the bottom, and a few tiers of angle iron are riveted inside the shell to stay and support the brick lining or monolithic (rammed) lining as the case may be. The tuyere arrangement having been marked off, the shell is placed into position, either on solid masonry or columns, according to whether the bottom is of the solid or drop type. The lining should be of a high-class refractory brick, or material that may be rammed in position instead of bricking. If the cupola shell is bricked in, a small space between the brickwork and the shell should be allowed for expansion; this space may be filled in with dry silica sand. If the lining is composed of a loose material, such as a highly refractory fire-clay, ganister, or a similar material which is usually rammed in, then venting by means of a wire should be adopted to allow the steam to escape when the material is being dried.

The lining above the melting zone up to the charging door may consist of a less refractory material. The distance from the charging door to the top of the stack is not important except to carry away the dust and gases emitted from the cupola when in blast. A dust catcher at the top of the cupola is a very desirable improvement, especially from a standpoint of cleanliness. If desired, suppliers will provide only the shell, including the melting zone, blast belt, drop doors, etc., as a separate part of the unit.

(*To be continued.*)

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Tough	37	10	0
Best selected	38	0	0
Sheets	72	0	0
India	48	0	0
Wire bars	44	0	0
Do., December	44	0	0
Do., January	44	0	0
Ingot bars	44	0	0
H.C. wire rods	46	0	0
Off. av. cash, Oct.	35	0	1 2/3
Do., 3 mths., Oct.	35	16	10 22/33
Do., Sttlmnt., Oct.	34	19	10 7/11
Do., Electro, Oct.	41	8	10 1/11
Do., B.S., Oct.	37	19	2
Do., wire bars, Oct.	41	17	8 8/11
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7½d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	7½d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6d.

TIN.

	£	s.	d.
Standard cash	128	2	6
Three months	130	2	6
English	129	15	0
Bars	131	15	0
Straits	131	10	0
Australian	129	15	0
Eastern	134	0	0
Banca (nom.)	143	5	0
Off. av. cash, Oct.	127	0	9 6/11
Do., 3 mths., Oct.	129	16	7 3/11
Do., Sttlmt., Oct.	127	0	2 8/11

SPELTER.

	£	s.	d.
Ordinary	13	3	9
Remelted	12	10	0
Hard	10	0	0
Electro 99.9	15	15	0
English	14	2	6
India	12	0	0
Zinc dust	23	0	0
Zinc ashes	3	5	0
Off. aver., Oct.	12	19	5 13/24
Aver. spot, Oct.	12	14	7 1/11

LEAD.

	£	s.	d.
Soft foreign ppt.	13	11	3
English	15	0	0
Off. average, Oct.	13	4	11 23/24
Average spot, Oct.	13	4	6 6/11

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do., V.M. ex-whf.	24	10	0
Rods	30	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	25	10	0
Crude	20	10	0

QUICKSILVER.

Quicksilver	$80

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 0 0
45/50%	£10 15 0
75%	£16 0 0
Ferro-vanadium—	
35/50%	12/8 lb. Va. plus 20%
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo. plus 25%
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£17 10 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 0 0
4/6% car.	£25 0 0
6/8% car.	£24 0 0
8/10% car.	£22 10 0
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£40 0 0
Max. 0·70% car.	£52 0 0
70%, carbon-free	11d. lb.
Nickel—99%	£225 to £230
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/1 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbon-free	1/6½ lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	5	0
Bundled steel and shrngs.	1	16	0	to	2	2	6
Mixed iron and steel	1	16	0	to	1	17	6
Heavy cast iron	2	5	0	to	2	7	6
Good machinery for foundries					2	10	0
Cleveland—							
Heavy steel	1	17	6	to	2	0	0
Steel turnings					1	7	0
Cast-iron borings					1	2	0
Heavy forge					2	7	6
W.I. piling scrap					2	0	0
Cast-iron scrap	2	2	6	to	2	5	0
Midlands—							
Light cast-iron scrap					1	17	6
Heavy wrought					2	7	6
Steel turnings, f.o.r.					0	18	6
Scotland—							
Heavy steel					2	0	0
Ordinary cast iron					2	7	6
Engineers' turnings					1	6	6
Cast-iron borings					1	10	0
Wrought-iron piling					2	5	0
Heavy machinery					2	12	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	21	0	0
Lead (less usual draft)	11	10	0
Tea lead	8	10	0
Zinc	6	0	0
New aluminium cuttings	62	0	0
Braziery copper	28	0	0
Gunmetal	25	0	0
Hollow pewter	82	0	0
Shaped black pewter	60	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	74/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
„ No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	79/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	9	15	0	to	10	5	0
Nut and bolt iron	8	5	0	to	8	10	0
Hoops							—
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip							—
Bolts and nuts, ¾ in. × 4 in.							—
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	15	0	to	9	15	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¼ in. (Untested)			6	17	6	& up.	
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)							—
Black sheets, 24g.	8	5	0	to	9	5	0
Galv. cor. shts.	9	7	6	to	10	0	0
Galv. flat sheets	9	17	6	to	10	10	0
Galv. fencing wire, 8g. plain							—
Billets, soft	5	5	0	to	5	12	6
Billets, hard					6	12	6
Sheet bars	5	0	0	to	5	10	0
Tin bars					5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11½d.
Tubes	16½d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	16.26
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	18.76
Malleable	18.76
Grey forge	17.76
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 25/-
„ furnace	15/6 to 16/-
Durham and Northumberland—	
„ foundry	15/- to 15/6
„ furnace	15/-
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	14/-
„	28×20 „	28/-
„	20×10 „	20/6
„	18¾×14 „	15/-
C.W.	20×14 „	13/-
„	28×20 „	—
„	20×10 „	—
„	18¾×14 „	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Oct.	29 ..	35	15	0	dec.	5/-
„	30 ..	35	0	0	„	15/-
Nov.	2 ..	35	7	6	inc.	7/6
„	3 ..	36	2	6	„	15/-
„	4 ..	35	13	9	dec.	8/9

Electrolytic Copper.

		£	s.	d.		
Oct.	29 ..	42	0	0	inc.	10/-
„	30 ..	41	0	0	dec.	20/-
Nov.	2 ..	42	0	0	inc.	20/-
„	3 ..	42	0	0	No change	
„	4 ..	41	0	0	dec.	20/-

Standard Tin (cash).

		£	s.	d.		
Oct.	29 ..	126	12	6	dec.	10/-
„	30 ..	127	2	6	inc.	10/-
Nov.	2 ..	127	7	6	„	5/-
„	3 ..	129	5	0	„	37/6
„	4 ..	128	2	6	dec.	22/6

Tin (English ingots).

		£	s.	d.		
Oct.	29 ..	128	5	0	dec.	7/6
„	30 ..	128	15	0	inc.	10/-
Nov.	2 ..	129	0	0	„	5/-
„	3 ..	130	15	0	„	35/-
„	4 ..	129	15	0	dec.	20/-

Zinc Sheets (English).

		£	s.	d.		
Oct.	29 ..	24	0	0	No	change
„	30 ..	24	0	0	„	„
Nov.	2 ..	24	0	0	„	„
„	3 ..	24	0	0	„	„
„	4 ..	24	0	0	„	„

Spelter (ordinary).

		£	s.	d.		
Oct.	29 ..	13	6	3	dec.	2/6
„	30 ..	13	2	6	„	3/9
Nov.	2 ..	13	7	6	inc.	5/-
„	3 ..	13	8	9	„	1/3
„	4 ..	13	3	9	dec.	5/-

Lead (English).

		£	s.	d.		
Oct.	29 ..	15	0	0	No change	
„	30 ..	15	0	0	„	„
Nov.	2 ..	15	0	0	„	„
„	3 ..	15	5	0	inc.	5/-
„	4 ..	15	0	0	dec.	5/-

AVERAGE MONTHLY PRICES OF IRON HOOPS.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 5 0	6 10 0	6 3 0
1897	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 8
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	7 0 0	6 11 6
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 9
1900	9 17 6	10 7 6	10 7 6	10 7 0	10 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 8
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 2
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 0
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 2 0½
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 1½
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5
1911	7 5 0	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 2½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	35 14 9
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1926	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	12 10 0	12 10 0	14 3 4
1928	12 10 0	12 7 6	12 0 0	11 13 6	11 15 0	11 12 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 14 10½
1929	11 10 0	11 10 0	11 10 0	11 10 0	11 9 0	11 5 0	11 5 0	11 5 0	11 5 0	11 2 0	11 0 0	11 0 0	11 5 11
1930	11 0 0	11 0 0	11 0 0	10 16 3	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 16 4½
1931	10 15 0	10 15 0	10 15 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

SITUATIONS VACANT AND WANTED.

METAL MOULDER seeks position as Foreman in small foundry; previous experience; first-class reference; London district preferred but not essential.—Box 934, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SALESMAN requires post; foundry plant and materials; able to give expert practical service to customers; wide personal connection. Highest references.—Inquiries to Box 924, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN.—Progressive Man wanted for large foundry, producing medium and light castings. Thorough knowledge essential of modern cupola practice, also machine and plate moulding on production lines.—State, age, experience, with references, Box 928, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY.—In connection with reorganisation of British foundry producing high-class castings, services of a Superintendent is required. Preference given to a competent Englishman with extensive practical experience of American methods as employed in automobile factories.—State experience in detail and in confidence to Box 930, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

OPENING for young, practical Working Moulder, age 25 to 30, with modern ideas, to train up for executive position in light-casting foundry.—Box 932, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKS Plant Maintenance Foreman wanted for ironfoundry. Working and practical knowledge of hydraulic and pneumatic machines and general plant upkeep. Must be prepared to work day or night shifts as required. Permanency to right man.—State experience, wages required, and whether in employment, to Box 922, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Any Member, Associate Member or Associate of the Institute of British Foundrymen who desires his qualifications to be inserted in the column must forward to the General Secretary of the Institute the following information:—(a) Name and address; (b) name of present employer (or last employer if unemployed); (c) brief particulars of qualifications, experience, and type of position required. The name will not be disclosed until the candidate is in communication with a prospective employer. Announcements will be inserted in two successive issues, unless announcers' requirements have been met with in the meantime.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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